

JANUARY, 1941.

I.—SUB-ATOMICS.

Zeeman effect of chrome alum. J. H. Van Vleck (*J. Chem. Physics*, 1940, 8, 787—789).—Theoretical. The Zeeman patterns of the absorption lines of Cr alum near $15,000\text{ cm}^{-1}$, observed by Spedding and Nutting (A., 1935, 1052), indicate that these lines are inter-system combinations. J. W. S.

Energy levels of chrome alum. R. Finkelstein and J. H. Van Vleck (*J. Chem. Physics*, 1940, 8, 790—797).—Theoretical. The energy levels for the d^3 configuration of the Cr^{+++} ion in Cr alum are calc. and discussed (cf. preceding abstract). J. W. S.

Temperature dependence of the work function of tungsten from measurement of contact potentials by the Kelvin method. J. G. Potter (*Physical Rev.*, 1940, [ii], 58, 623—632).—The Kelvin method is adapted for measurements between filaments in vac. Measurements between a heated and a cool W filament indicate an increase in w , the work function of W, with temp., of 6.3×10^{-5} v. per degree, which appears to be comparatively independent of the degree of surface contamination. The effect is distinguished from changes in w due to temp. variations in contaminating layers tending to obscure the true temp. coeff. The temp. effect probably resides primarily in the thermodynamic potential of the electrons inside the metal and not in the potential barrier at the surface. The coeff. obtained eliminates the discrepancy between the experimental val. of A in the Richardson equation and the theoretical factor of 120 without introducing a reflexion coeff. N. M. B.

Electron scattering in bromine gas. C. H. Shaw and T. M. Snyder (*Physical Rev.*, 1940, [ii], 58, 600—602).—Calculations are made on the angular dependence of electron scattering in Br gas with the scattering phases previously obtained (cf. A., 1940, I, 305). For the lower energies it is essential to include at. polarisation in the calculations of the phase defects. Results are compared with experimental work by Arnot (cf. A., 1934, 577). N. M. B.

Scattering of fast electrons in helium. J. B. H. Kuper and E. Teller (*Physical Rev.*, 1940, [ii], 58, 602—603).—Neglect of inelastic scattering explains the failure of the quantum theory of elastic scattering to account for experimental data for 50—80-kv. electrons in He (cf. A., 1938, I, 425). Computation of the cross-sections including inelastic and elastic collisions by an approx. method gives satisfactory results. N. M. B.

Secondary emission from films of platinum on aluminium. P. L. Copland (*Physical Rev.*, 1940, [ii], 58, 604—607; cf. A., 1939, I, 441; Hastings, A., 1940, I, 276).—Experimental results indicate a direct proportionality between the primary energy (up to 800 e.v.) and the max. depth of origin of the secondaries. These depths accord with the vals. to be expected from existing theories. The max. depth within the target influencing the secondary emission increases more rapidly for primary energies >800 e.v. than for those below. N. M. B.

Relative secondary electron emission due to He, Ne, and A ions bombarding a hot nickel target. (Miss) M. Healea and (Miss) C. Houtermans (*Physical Rev.*, 1940, [ii], 58, 608—610).—The no. of electrons emitted per positive ion from a degassed Ni target was measured. For He (450—1650 e.v.) the emission increase was 49—107%; for Ne (900—1275 e.v.) the increase was 43—57%; for A (680—1480 e.v.) it was 11—18%. These results disagree with those of Hill (cf. A., 1939, I, 230) but confirm those found for H_2^+ and D_2^+ (cf. *ibid.*, 394) in showing a smaller emission for the heavier ion at the same energy. The % of positive ions reflected increased with the energy of the primary ions and was smaller for the heavier ions. N. M. B.

Precise determination of the fine structure constant. R. F. Christy and J. M. Keller (*Physical Rev.*, 1940, [ii], 58, 658).—Mathematical. Calculations based on the theoretical behaviour of the X-ray spin doublet splitting for elements of high at. no. lead to the val. $1/a = hc/2\pi e^2 = 136.95 \pm 0.13$. N. M. B.

Values of e , e/m , h/e , and a . R. T. Birge (*Physical Rev.*, 1940, [ii], 58, 658—659).—With the best available data, the val. of h/e calc. from the Rydberg const. formula is $(1.37929 \pm 0.00040) \times 10^{-17}$, contrasted with the observed val. 1.3765 ± 0.0003 . The new val. of $1/a$ (cf. preceding abstract) accords with that calc. from the Rydberg const. formula, indicating that the h/e discrepancy lies in the observed val. N. M. B.

Angular distribution of fast neutrons scattered by hydrogen, deuterium, and helium. H. H. Barschall and M. H. Kanner (*Physical Rev.*, 1940, [ii], 58, 590—596).—The angular distribution of d - d neutrons scattered by H, D, and He was measured by observing the energy distribution of the recoil particles in an ionisation chamber. Curves show that the scattering in H and D is essentially isotropic in the angular interval examined. In He, collisions with small energy transfer were more frequent than large-angle scattering. Estimates of the abs. differential scattering cross-section of He are given. N. M. B.

Steady-state diffusion under conditions of generalised source and incident current distributions. E. A. Schuchard and E. A. Uehling (*Physical Rev.*, 1940, [ii], 58, 611—623).—Mathematical. The method of Laplace transformations is extended to the more general case of neutron diffusion in half-infinite media containing source distributions, and an exact expression for the emergent current distribution is obtained. N. M. B.

Relative cross-sections of the (n, α) and (n, p) reactions produced by fast neutrons. T. Amaki and A. Sugimoto (*Physical Rev.*, 1940, [ii], 58, 659).—Approx. cross-sections, calc. from measured intensities of the induced activities, are reported for 17 reactions induced by bombardments with neutrons from Li or Be. N. M. B.

Carbon isotopes of mass 10 and 11. L. A. Delsasso, M. G. White, W. Barkas, and E. C. Creutz (*Physical Rev.*, 1940, [ii], 58, 586—590; cf. A., 1939, I, 505).— ^{12}C was produced by the two new reactions $^{11}\text{B}(p, n)^{12}\text{C}$ and $^{14}\text{N}(p, \alpha)^{12}\text{C}$. The upper limit of the positron spectrum of ^{12}C , measured by a cloud chamber, was 0.95 ± 0.03 Me.v. A new isotope, ^{10}C , of period 8.8 ± 0.8 sec., was produced by the reaction $^{10}\text{B}(p, n)^{10}\text{C}$. The upper limit of the positron spectrum was 3.36 ± 0.1 Me.v. The relation of the measurements to isobaric splitting and properties of light nuclei is discussed. N. M. B.

Calcium metaphosphate as a target for bombardment of phosphorus by high-voltage ion beams. D. E. Hull and J. H. Williams (*Rev. Sci. Instr.*, 1940, 11, 299).— $\text{Ca}(\text{PO}_3)_2$ is a more suitable substance than amorphous P, or P_2O_5 , for use as a target in investigations of the bombardment of P, as its v.p. is not high at the temp. produced by the ion beam. The method of attachment of $\text{Ca}(\text{PO}_3)_2$ to Pt foil to form the target is described, and a chemical method of removing it after the bombardment in order to examine the radioactive P produced is outlined. A. J. M.

($d, 2n$) Reaction in copper. R. S. Livingston and B. T. Wright (*Physical Rev.*, 1940, [ii], 58, 656).—Cu foils were bombarded by 16-Me.v. deuterons from a cyclotron and a strong activity attributed to $^{63}\text{Cu}(d, 2n)^{62}\text{Zn}$ (38 min.) was observed. Activity-cross-section curves for the formation of ^{63}Zn and of ^{64}Cu (12.8 hr.) are given and discussed. The calc. 2

threshold for the ($d, 2n$) reaction is ~ 7 and the observed val. ~ 7.5 Me.v. N. M. B.

Cloud-chamber studies of fission fragment tracks. K. J. Brostrom, J. K. Boggild, and T. Lauritsen (*Physical Rev.*, 1940, [ii], 58, 651—653; cf. Corson, A., 1939, I, 234).—With a large Wilson chamber containing gases at ~ 5 cm. pressure, photographs of tracks of fission fragments show branching by nuclear collision many times in a single track. An analysis of measurable branches indicates a range-velocity relation different from that for light particles. In A, deviations are very marked in the first part of the range, thereafter decreasing; in H₂, the curvatures are smaller. Range-velocity curves are given. N. M. B.

Scattering and stopping of fission fragments. N. Bohr (*Physical Rev.*, 1940, [ii], 58, 654—655).—A mathematical consideration of the results of Brostrom (cf. preceding abstract). Differences between the fission tracks and those of protons and α -particles are shown to be due to the high charge and mass of the fission fragments, which imply that nuclear collisions play a much greater part in the phenomenon. N. M. B.

Fission products of uranium by fast neutrons. Y. Nishina, T. Yasaki, K. Kimura, and M. Ikawa (*Physical Rev.*, 1940, [ii], 58, 660—661; cf. A., 1940, I, 341).—Pd after bombardment by fast neutrons gave a decay curve showing 17-hr. and 26-min. periods. It was shown by separation and ptn. of Ag that the 17-hr. Pd must be ¹¹²Pd and gives rise to ¹¹²Ag (3.5 hr.). N. M. B.

Deuteron bombardment of silver. R. S. Krishnan (*Proc. Camb. Phil. Soc.*, 1940, 36, 500—506; cf. A., 1939, I, 592).—Deuteron bombardment of Ag gives radioactive isotopes with periods 2.4 min., 26 min., and 225 days isotopic with Ag, and 6.7 hr. and 1 year isotopic with Cd. Energy-yield curves have been determined. L. J. J.

Deuteron bombardment of heavy elements. I. Mercury, thallium, and lead. R. S. Krishnan and E. A. Nahum (*Proc. Camb. Phil. Soc.*, 1940, 36, 490—499).—Hg, Tl, Pb, and Bi bombarded with 9-Me.v. deuterons, give radioactive isotopes with periods 5.5 min., 48 min., 36 hr., 60 days; 4.4 min., 10.5 hr., 44 hr., 13 days; 10.25 min., 2.75 hr., 54 hr.; and 18 hr. and 6.35 days, respectively. The 10.25-min. Pb emits positrons. Absorption data are recorded for the radiations. L. J. J.

Chemistry within the atom. S. C. Lind (*Science*, 1940, 92, 227—231). L. S. T.

Air mass effect on cosmic-ray intensity. D. H. Loughridge and P. F. Gast (*Physical Rev.*, 1940, [ii], 58, 583—585; cf. A., 1940, I, 54; Nishina, *ibid.*, 309).—Observations over a range of atm. conditions on shipboard establish an effect on cosmic-ray intensity at the boundaries of different types of air masses. The effect is of the Blackett seasonal-variation type. N. M. B.

Fine structure pattern of cosmic rays at Mexico City. E. J. Schremp and A. Baños, jun. (*Physical Rev.*, 1940, [ii], 58, 662—663; cf. Johnson, A., 1935, 1297).—Preliminary results of a search for fine structure analogous to that found elsewhere by Ribner (cf. A., 1940, I, 54) and Cooper (cf. *ibid.*, 400) are reported. N. M. B.

Measurement of cosmic rays at Agra and Kodaikanal. A. K. Das and M. Salaruddin (*Indian J. Physics*, 1940, 14, 191—205).—Mean intensity vals. of cosmic rays at Agra and Kodaikanal are 1.545 ± 0.007 and 2.333 ± 0.010 pairs of ions per c.c. per sec. respectively and the absorption coeff. is 0.202 per m. of H₂O. Diurnal variation of intensity has been studied, but no correlation has been established between intensity variation and sun-spot nos. or flocculi figures. W. R. A.

Ultra-soft components of cosmic rays. II. G. P. S. Occhialini and M. Schönberg (*Ann. Acad. Brasil. Sci.*, 1940, 12, 197—202).—The energy of photons in small showers is measured. F. R. G.

Penetrating cosmic-ray showers. P. A. Pompeia, M. D. de Souza Santos, and G. Wataghin (*Ann. Acad. Brasil. Sci.*, 1940, 12, 229—230).—Some soft radiation is shown to be associated with the penetrating core of the shower. Measurements are recorded showing the existence underground of groups or pairs of associated penetrating particles. F. R. G.

Casimir's method of spin summation in the case of the meson. S. Sakata and M. Taketani (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1940, 38, 1—11).—Theoretical. J. W. S.

Scattering of neutral mesons. F. Booth and A. H. Wilson (*Proc. Camb. Phil. Soc.*, 1940, 36, 446—453).—According to the quantised theory scattering of neutral mesons by protons due to the g_1 (point charge) interaction is \ll that for charged mesons, but the anomaly due to the g_2 (dipole) interaction remains. L. J. J.

Electrostatic dipole moment of a nucleus in the meson theory. S. T. Ma (*Proc. Camb. Phil. Soc.*, 1940, 36, 438—440).—Emission and absorption of a meson gives rise to an electrostatic nuclear dipole moment, which is evaluated. L. J. J.

Deviation from the Coulomb law for the proton. S. T. Ma (*Proc. Camb. Phil. Soc.*, 1940, 36, 441—445).—Deviations from the Coulomb law calc. on the basis of Heitler's hypothesis of higher states for nuclear particles (A., 1940, I, 91) are shown to be $<$ those calc. on the basis of current meson theory. L. J. J.

Theoretical atomic distribution curve for liquid argon at 90° K. G. S. Rushbrooke (*Proc. Roy. Soc. Edin.*, 1940, 60, 182—191).—Mathematical. The position, height, and shape of the first max. in the at. distribution curve of liquid A are calc. on the basis of Lennard-Jones and Devonshire's model for the structure of liquid A (A., 1938, I, 352). The shape agrees closely with that of a Wall peak (A., 1939, I, 133). More complete curves, showing two further peaks, are calc. on two alternative hypotheses as to the structure of liquid A. O. D. S.

Propagation of electromagnetic waves in an ionised medium and the calculation of the true heights of the ionised layers of the atmosphere. O. Rydbeck (*Phil. Mag.*, 1940, [vii], 30, 282—293).—Theoretical. A. J. M.

II.—MOLECULAR STRUCTURE.

Nuclear isotope shift in the spectrum of ZnH. S. Mrozowski (*Physical Rev.*, 1940, [ii], 58, 597—599).—A study by Fabry-Perot etalon of the structure of lines in the (0, 0) band of the ²¹I₁ \rightarrow ² Σ system of ZnH excited in a hollow-cathode tube shows structure, due to Zn isotope effect, for lines near the head of the ^oP₁₂ branch. The measured shifts are $>$ those calc. by formulae for vibrational and rotational isotopic effects and indicate an additional shift, of at least partly nuclear origin, ~ 0.007 cm.⁻¹ for the consecutive even-mass Zn isotopes. The shifts are \sim one tenth of, and opposite in direction to, the analogous nuclear shifts in HgH (cf. A., 1940, I, 401). N. M. B.

Presence of HNC in hydrogen cyanide. G. Herzberg (*J. Chem. Physics*, 1940, 8, 847—848).—The presence of the weak 2062 cm.⁻¹ frequency in the Raman spectrum of HCN can be explained quantitatively as due to H¹³CN and does not support the view that traces of HNC are present in HCN (cf. Dadiou, A., 1931, 998). It is inferred that the weak 4.95 μ . band in the infra-red spectrum of saturated aq. HCN is probably not due to HNC (cf. Gordy and Williams, A., 1936, 406). J. W. S.

Fine structure of the 3.35 μ . band of ethylene. L. G. Smith (*J. Chem. Physics*, 1940, 8, 798—799).—The rotation structure of the parallel band of C₂H₄ at 3.35 μ ., due to C—H stretching vibration, has been investigated, and the mean of the two large moments of inertia of C₂H₄ is calc. as 30.08×10^{-40} g.-cm.² This val., combined with the val. $C = 5.70 \times 10^{-40}$ g.-cm.² for the small moment, leads to vals. of 33.20×10^{-40} and 27.50×10^{-40} g.-cm.² for the large moments of inertia A and B, respectively, in accord with previous results (Badger, A., 1935, 1448). J. W. S.

Ultra-violet absorption of nitrogen peroxide. L. Harris, G. W. King, W. S. Benedict, and R. W. B. Pearse (*J. Chem. Physics*, 1940, 8, 765—774).—Analysis of eight discrete and several diffuse absorption bands of NO₂ in the region 2300—2700 Å. indicates that the upper electronic state intervals are 523 and 714 cm.⁻¹ and the lower state intervals 749 and 1319 cm.⁻¹ Temp. coeff. measurements indicate that the origin of the system is at 2491 Å. Possibilities of reconciling these frequencies with those derived from the infra-red spectrum are discussed. J. W. S.

Rotational structure of the ultra-violet bands of nitrogen peroxide. L. Harris and G. W. King (*J. Chem. Physics*, 1940, 8, 775—784).—The spectroscopic consts. of the 2491 Å. band of NO_2 have been derived. The N—O distance is 1.28 and 1.41 Å. in the lower and excited states, respectively, whilst the O—N—O angle is $\sim 154^\circ$ in both states. J. W. S.

Infra-red absorption of phenol and its halogen derivatives in the region of the second overtone of the OH absorption. O. R. Wulf and E. J. Jones (*J. Chem. Physics*, 1940, 8, 745—752).—The absorption spectra of CCl_4 solutions of PhOH , $\text{C}_6\text{Cl}_5\text{OH}$, and of the compounds $o\text{-C}_6\text{H}_4\text{XOH}$ and 2:4:6:1- $\text{C}_6\text{H}_2\text{X}_3\text{OH}$ (X = Cl, Br, or I) have been studied in the region 9600—10,600 cm^{-1} . As in the region of the first overtone, the o -compounds show a small absorption peak in the normal OH position, and a larger peak displaced to lower ν , but subsidiary peaks are more pronounced. The displacements of the cis -peaks are in the order of the polarisability of the halogen atoms. The variation in the absorption of PhOH solutions with concn. indicates that in CCl_4 it is associated into a series of polymerides. J. W. S.

Combination frequencies associated with the first and second overtone and fundamental OH absorption in phenol and its halogen derivatives. O. R. Wulf, E. J. Jones, and (Miss) L. S. Deming (*J. Chem. Physics*, 1940, 8, 753—765).—The absorption frequencies of PhOH , $\text{C}_6\text{Cl}_5\text{OH}$, and the compounds $o\text{-C}_6\text{H}_4\text{XOH}$ and 2:4:6:1- $\text{C}_6\text{H}_2\text{X}_3\text{OH}$ (X = Cl, Br, or I) in the region 7500—8450 cm^{-1} are interpreted as combination frequencies in which the valency vibration of the OH-group is combined with nuclear frequencies. Some of these combination frequencies underlie the trans -peaks of o -halogen compounds. A close correspondence exists between the frequencies involved in these combinations and those observed in the far infra-red and Raman spectra. J. W. S.

Absorption spectra of gaseous methylamine and dimethylamine in the photographic infra-red. A. P. Cleaves, H. Sponer, and L. G. Bonner (*J. Chem. Physics*, 1940, 8, 784—787).—The absorption spectra of gaseous NH_2Me and NHMe_2 have been studied in the region 6000—12,000 Å. Bands are observed in both gases at 7940, 9100, and 11,800 Å., in NH_2Me at 9940, 10,070, and 10,330 Å., and in NHMe_2 at 8045, 10,360, and 10,625 Å. As far as possible the bands are assigned to overtones and combinations of the fundamental N—H and C—H valency vibrations. J. W. S.

Lattice vibrations of crystals and the corresponding vibrations of their solutions. II. S. Freed and S. I. Weissman (*J. Chem. Physics*, 1940, 8, 840—842; cf. A., 1940, I, 192).—The absorption spectrum of anhyd. EuF_3 shows repetitions of the main absorption band at intervals corresponding with a lattice vibration of $\sim 340 \text{ cm}^{-1}$, a val. $>$ that observed in hydrated salts and indicating the greater tightness of binding in the anhyd. crystals. In abs. EtOH , anhyd. $\text{Eu}(\text{NO}_3)_3$ shows vibrational intervals of 210 and 90 cm^{-1} , whilst EuCl_3 shows a 165 cm^{-1} vibration; in H_2O , however, both $\text{Eu}(\text{NO}_3)_3$ and EuCl_3 show a frequency of 125 cm^{-1} . Addition of H_2O to the EtOH solutions causes the repetitions to become diffuse. Solutions of Eu acetylacetonate in C_6H_6 or CCl_4 show no repetitions of the main absorption band. The theory of the repetitions is discussed. J. W. S.

Typical colour curves and their application for purity tests in physiological researches.—See A., 1941, III, 62.

Photodehydrogenation of sterols. Δ^2 - Δ^4 -Cholestadiene.—See A., 1941, II, 11.

Fluorescence of hydrocarbons and of their mixtures with naphthacene.—See A., 1941, II, 8.

Lifetime of fluorescence in diacetyl and acetone. G. M. Almy and S. Anderson (*J. Chem. Physics*, 1940, 8, 805—814).—Direct measurements with a phosphoroscope and measurements of the diffusion of excited mols. from a beam of exciting illumination indicate that the mean life of fluorescence in Ac_2 vapour is 1.65×10^{-9} sec. Integration of the absorption coeff. over the band associated with the fluorescence, however, leads to a mean life of $\sim 10^{-5}$ sec. This discrepancy can be explained by supposing that after light absorption the Ac_2 mol. in an excited state A passes without radiation into a long-lived state M , lying near A , and that fluorescence occurs only after return to A . The state M may correspond with a tautomeric rearrangement of the mol. COMe_2 , irradiated with 3130 Å., shows fluorescence identical with that of Ac_2

irradiated with 4358 Å., but the fluorescence increases with time according to a growth curve $I_t = I_0(1 - e^{-kt})$. It is produced immediately and in high intensity by the addition of Ac_2 . Its mean life in COMe_2 is equal to that in Ac_2 and is independent of the intensity of the exciting illumination. It is inferred that the same mol., probably Ac_2 , is responsible for the fluorescence in the two cases, and possible mechanisms of the excitation of Ac_2 in COMe_2 are discussed. J. W. S.

Raman spectrum of sugar. A. L. S. Rao (*Indian J. Physics*, 1940, 14, 207—212).—An aq. solution of sucrose gave 16 Raman frequencies which have been assigned to constituent linkings and compared with frequencies obtained for glucose and cryst. sucrose. W. R. A.

Dielectric constant of an electronic medium at medium radio-frequency. S. R. Khastgir and C. Choudhury (*Indian J. Physics*, 1940, 14, 213—229).—Variation of effective dielectric const. (ϵ) of the electronic medium in the anode screen-grid space of a thermionic valve under varying conditions at medium radio frequencies (f) has been studied. The no-beat technique of a double heterodyne method was employed. ϵ was calc. according to the Lorentz formula for the dielectric const. of a frictionless electronic medium, allowance being made for the conductivity of the medium, and a multiplying factor (μ) was introduced to obtain the effect of time of stay (t) of the electrons in the inter-electrode space. At fixed f and t , ϵ decreased approx. with increase of the thermionic current (i). With i and t fixed, ϵ decreased $\propto f^2$. When i and f were const. the change of capacity on filling the inter-electrode space with electrons increased with increasing t . μ is, therefore, independent of f , and dependent only on t . The parabolic variation in ϵ with the variation of the magnitude of the measuring field was not observed at the frequencies used; however, a steady variation in some cases was found and is explained. W. R. A.

Charge distribution and dipole moment of the C—H bond. C. A. Coulson (*Proc. Camb. Phil. Soc.*, 1940, 36, 509—510).—From CH_4 wave functions, each H atom in CH_4 has a net positive charge 0.101e, giving a rather high val. 0.53 D. for the dipole moment of C—H. L. J. J.

Solvent action on optical rotatory power. III. Influence of liquid structure on the interaction of dipoles. C. O. Beckmann and H. C. Marks. IV. Rotivity of diethyl dipropionyl- d -tartrate and l -menthyl acetate in aromatic and aliphatic solvents. H. C. Marks and C. O. Beckmann (*J. Chem. Physics*, 1940, 8, 827—830, 831—839; cf. A., 1937, I, 65; 1938, I, 232).—III. Theoretical. By introducing the London dispersion forces and the structural characteristics of a liquid system, an equation for the change of rotivity per g.-mol. of dipole solvent in unit vol. of a solution is obtained, of similar form to that deduced previously for a mixture of gases which are perfect except for dipole interaction.

IV. The vals. of $[\alpha]_{4361}^D$ for solutions of Et_2 dipropionyl- d -tartrate in various binary mixtures of cyclohexane, cyclohexyl cyanide, 1-nitro-1-methylcyclohexane, PhCN , PhNO_2 , and C_6H_6 , have been measured. The results are discussed with reference to the theory, and agreement is found over wide ranges of concn. J. W. S.

Energy levels of a rotating vibrator. I. Sandeman (*Proc. Roy. Soc. Edin.*, 1940, 60, 210—223).—Mathematical. Dunham's theoretical work for the diat. mol. is amplified and simplified, and the calculation of mol. consts. from spectral data is shortened. O. D. S.

Structure of the phosphorus chloronitrides. G. N. Copley (*Chem. and Ind.*, 1940, 789—790).—The usually accepted structures of the P chloronitrides, $(\text{PNCl}_2)_n$ ($n = 3-7$), involving conjugated rings of alternate N and P atoms is criticised on account of the instability of eight- and higher-membered rings. New formulae, in which, however, the cyclic formula for the simplest member ($n = 3$) is retained, are proposed. Structural formulae indicating the course of the reaction $\text{P}_2\text{N}_3(\text{NH}_2)_2 + 3\text{NH}_3 \rightarrow (\text{PN}_2\text{H})_3 \rightarrow \text{P}_3\text{N}_5$ are given. A. J. M.

III.—CRYSTAL STRUCTURE.

Correction of lattice spacings for refraction. A. J. C. Wilson (*Proc. Camb. Phil. Soc.*, 1940, 36, 485—489).—The true lattice spacing of a cubic crystal is $>$ the extrapolated lattice spacing by a fraction $1-n$ of itself. Refraction makes a relatively small contribution to line width. L. J. J.

Structure of *m*-dinitrobenzene by Patterson Fourier summation. K. Banerjee and M. Ganguly (*Indian J. Physics*, 1940, 14, 231—236).—From the analysis interat. vectors in the unit cell have been calc. and the at. arrangements have been determined. W. R. A.

Crystal structure models for close-packed systems. D. B. Langmuir and R. B. Nelson (*Rev. Sci. Instr.*, 1940, 11, 295—297).—The method uses transparent boxes with plane walls, the edges of which have the relative directions along which rows of atoms are close-packed in the given crystal structure. Spheres poured into the box automatically take up positions corresponding with the lattice for which the box was designed. The edges and surfaces which should bound models for the face-centred cubic, simple cubic, body-centred cubic, and hexagonal close-packed systems are given. A. J. M.

Dependence of crystal structure on chemical properties. I. I. Zaslavski (*J. Gen. Chem. Russ.*, 1940, 10, 369—379).—Three types of crystal structure are distinguished for diat. mols. of the type MX, viz., that of ZnS, of NiAs, and of NaCl. These types lie within definite areas of the at. structure-mol. vol. diagrams. This is shown to hold for 141 salts of the type MX. R. T.

Secondary emission and electron diffraction on a glass surface. H. Kamogawa (*Physical Rev.*, 1940, [ii], 58, 660; cf. A., 1938, I, 441).—Electron diffraction patterns were obtained by a method which maintained the glass surface electrically neutral. Polished optical glass gave haloes which suggest a structure of the surface layer different from that of the bulk glass. Surfaces of optical glass containing a high % of BaO or PbO showed, after prolonged exposure to damp H₂S, diffraction rings indicating the formation of films ~1 light λ thick of BaSO₄ or PbS—PbSO₄. N. M. B.

Interpretation of ferromagnetic colloid patterns on ferromagnetic crystal surfaces. W. C. Elmore (*Physical Rev.*, 1940, [ii], 58, 640—642; cf. Heaps, A., 1940, I, 254).—It is shown that the bodily motion of particles rather than a magneto-optic effect (cf. McKeehan, *ibid.*, 350) is chiefly responsible for field-induced changes in ferromagnetic colloid patterns on ferromagnetic crystal surfaces. A simple relation between colloid concn. and magnetic field intensity near the crystal surface is deduced from Boltzmann's distribution law. The formation of elongated chains of particles in a colloid in a magnetic field is shown to be unlikely if the particles are sufficiently small. N. M. B.

Stability of crystal lattices. III. Attempt to calculate the tensile strength of a cubic lattice by static considerations. M. Born and R. Fürth (*Proc. Camb. Phil. Soc.*, 1940, 36, 454—465; cf. A., 1940, I, 288).—The energy density of a cubic lattice, homogeneously deformed by a force in the direction of one axis, is calc., and equilibrium and stability conditions for small additional deformations in an arbitrary direction are derived. Tensile strength so calc. is not in agreement with experimental data. L. J. J.

Stability of crystal lattices. IV. M. Born and R. D. Misra (*Proc. Camb. Phil. Soc.*, 1940, 36, 466—478; cf. preceding abstract).—A method is developed for deriving higher terms than the second in the expression for deformation energy for the case of a highly strained cryst. lattice. L. J. J.

Elasticity of crystals. S. Sigel and R. Cummerow (*J. Chem. Physics*, 1940, 8, 847).—A plot of the reduced temp. ($\theta = T/T_m$, where T_m = k. = m.p.) against the ratio of the val. of the modulus of elasticity at T° K. to its val. at $\theta = 0.5$ yields curves which are coincident for Pb, Al, and Na, but do not approach zero at the m.p. (cf. Born, A., 1939, I, 552). Data for NaCl do not fall on the same curve as those for the metals. J. W. S.

IV.—PHYSICAL PROPERTIES OF PURE SUBSTANCES.

Thermal and electrical conductivities of metals and alloys. W. F. Chubb (*Phil. Mag.*, 1940, [vii], 30, 323—330).—A review of relations existing between thermal and electrical conductivities of metals and alloys is given, and it is concluded that the relative inaccuracy of thermal conductivity determinations accounts for the anomalies that have arisen in their interpretation. This, however, does not apply to the Wiedemann-Franz and the Wiedemann-Franz-Lorenz laws, deviations from which are not due to errors in thermal conductivity

determinations. These laws are not strictly applicable to alloy series. A. J. M.

Theoretical magnetic susceptibilities of metallic lithium and sodium. J. B. Sampson and F. Seitz (*Physical Rev.*, 1940, [ii], 58, 633—639).—Inclusion of Bardeen's effective masses and exchange and correlation terms in computations using present knowledge of the electronic structure of Li and Na appreciably affects the theoretical paramagnetism for free electrons, giving results differing from those from Pauli's equation with assumption that electrons are free and that exchange and correlation terms may be neglected. The calc. susceptibility for Na is close to the observed val., but for Li is about twice the highest experimental one. Sources of error are examined. The level density curves obtained from X-ray emission curves are discussed, and it is concluded that all details of these curves cannot be explained on the ordinarily used simple picture. N. M. B.

Magnetic properties of metallic cerium. C. Starr and A. R. Kaufmann (*Physical Rev.*, 1940, [ii], 58, 657).—Data for the magnetisation per g. of Ce as a function of field strength at various temp., and the magnetisation intercept, representing the saturation magnetisation of the ferromagnetic term, are plotted. The observed intercept vals. show anomalies possibly due to the presence of Fe impurity. Effects of heat-treatment, annealing, and ageing are examined. N. M. B.

Magnetic evidence regarding the state of metallic ions in phosphate glasses. S. S. Bhatnagar, B. D. Khosla, and R. Chand (*J. Indian Chem. Soc.*, 1940, 17, 515—520).—Magnetic susceptibility measurements have been made on glasses prepared from NaNH₄HPO₄ with addition of traces of Mn, Co, or Ni, with or without subsequent reduction by the addition of tartaric acid. The results indicate that in reduced colourless Mn glasses the metal is present as Mn^{II}, whilst in the violet-pink glass it exists as a mixture of Mn^{II} and Mn^{III}. Co in the glass, whether reduced or not, is present as Co^{II}. In yellow glass Ni is present as Ni^{II}, but in the opaque reduced glass metallic Ni is present. J. W. S.

Measurements of high-frequency permeability. W. Jackson (*Phil. Mag.*, 1940, [vii], 30, 247—251).—The high-frequency permeability of mumetal, stalloy, mild steel, and 6% W steel, hardened and unhardened, has been determined. The effect of the magnetising force on the permeability is considered. A. J. M.

V.—SOLUTIONS AND MIXTURES (INCLUDING COLLOIDS).

Thermodynamics of real gas mixtures. II. Specific heat of gas mixtures. E. Justi (*Feuerungstechn.*, 1939, 27, 297—301; cf. A., 1939, I, 363).—On mixing gases deviations occur from Amagat's law of the additivity of vols., and from Dalton's law of the additivity of pressures, which can be expressed for medium pressures by simple formulae for all temp. and concns. The sp. heat of real gas mixtures is not additive, because of interaction between dissimilar mols. For the mixtures He-A and CH₄-C₂H₆ the sp. heats were deduced from p - v - T measurements, and for H₂-N₂ from the Joule-Thomson effect. R. E. C.

Temperature assignments of experimental thermal diffusion coefficients. H. Brown (*Physical Rev.*, 1940, [ii], 58, 661—662; cf. A., 1940, I, 155; Jones, *ibid.*, 389).—Mathematical. N. M. B.

Confirmation of the theory of thermal diffusion. T. I. Taylor and G. Glockler (*J. Chem. Physics*, 1940, 8, 843—844).—Using a 40-ft. diffusion column, with wall spacing of 0.95 cm., the separation factor for CH₄ at various pressures is in fairly good agreement with theory (A., 1939, I, 395). Max. concn. of ¹³CH₄ was attained at 28 mm. pressure. J. W. S.

Viscosity in the system ammonia-ethyl alcohol. A. Murta-zav and Z. Skljárova (*J. Gen. Chem. Russ.*, 1940, 10, 289—290).—The η -composition curve (temp. not specified) does not suggest compound formation. R. T.

Precipitation in the alloys of copper and silver during age-hardening. W. F. Cox and C. Sykes (*J. Inst. Metals*, 1940, 66, 381—387).—The pptn. of the second phase on ageing a quenched 7.7% Cu-Ag alloy at 240° and a quenched 5.9% Ag-Cu alloy at 380° has been followed by X-ray examination and by diamond pyramid hardness tests. In both alloys the lines of the pptd. phase are visible after 1 hr., and max.

hardness is attained in about 2 hr. The lattice parameters of the two phases are the same for both alloys within $\pm 0.02\%$ at max. hardness and the min. size of the pptd. particles is $\sim 100 \text{ \AA}$. A. R. P.

Hardening in the system gold-indium. F. Weibke (*Z. Elektrochem.*, 1940, **46**, 346—348; cf. A., 1939, I, 69).—Alloys with 7% of In quenched from 600° and tempered for 2 hr. at 300° show an increase of Brinell hardness up to 56% compared with quenched but untempered alloys. Alloys with 1% do not show this effect unless they are rolled before tempering, when an increase of 32% is obtained. F. L. U.

Gold-cadmium alloys rich in gold. E. A. Owen and E. A. O'D. Roberts (*J. Inst. Metals*, 1940, **66**, 389—400).—X-Ray investigation has revealed the existence of two new phases in the area previously believed to be pure α . The α_1 phase has a face-centred tetragonal structure $a \ 4.1074$, $c/a \ 1.0037$ and the α_2 phase a hexagonal structure $a \ 2.9026$, $c/a \ 1.6407$. The α_1 region extends from Cd 24.5 to 26.0 at.-% at room temp. and closes at Cd 25 at.-% at 425° ; it is bounded by a very narrow (0.6 at.-% wide) $\alpha_1 + \alpha_2$ region on the Cd side and by a much broader $\alpha + \alpha_1$ region (Cd ~ 15 at.-% at 20° to 23.4 at.-% at 425°) on the Au side. Above 425° there is a narrow band of $\alpha + \alpha_2$ extending in a curve from Cd 23.4—25.3 at.-% at 425° to 32.5—34 at.-% at 625° . The α_2 field closes on a peritectic horizontal at 625° , Cd 34 at.-%, and extends to Cd 35.7 at.-% at the eutectic temp. (612°). A. R. P.

Equilibrium diagram of the system copper-nickel-silicon. M. Okamoto (*Nippon Kinzoku Gakkai-Si*, 1939, **3**, 365—402).—The diagram is very complex since no pseudo-binary system is formed between any of the constituents of the Cu-Si and Ni-Si systems, nor does any extensive series of solid solutions exist between them. A ternary compound is formed in the range Si 12—15 and Ni 11—12% by a peritectic reaction at 859° and the ternary γ phase is formed by a similar reaction at a max. of 954° . The system contains 13 primary crystal phases, 26 univariant curves, and 13 non-variant points. A. R. P.

Ternary solid solution copper-nickel-silicon. M. Okamoto (*Nippon Kinzoku Gakkai-Si*, 1939, **3**, 411—420).—The α -range at the Cu end of the system has been delineated; from the solution saturated at high temp. the γ , γ' , β' , or κ phases are pptd. on cooling according to the composition, and all may induce pptn.-hardening when the quenched alloys are reheated at 425 — 550° . Max. hardness is not shown by alloys on the Cu-Ni₂Si line. A. R. P.

Solubility of lanthanum in aluminium, magnesium, and homogeneous magnesium-aluminium alloys. F. Weibke and W. Schmidt (*Z. Elektrochem.*, 1940, **46**, 357—364).—La is insol. in Al. It begins to dissolve in Mg at 450° and the solubility reaches 3% at 609° , the eutectic temp. Addition of Al to the Mg up to saturation does not greatly affect the solubility of La, but considerably reduces the initial m.p. Of the neighbouring elements Ba is nearly insol. in solid Mg, whilst Ce dissolves to the extent of 2.2% at the eutectic point (585°), the solubility decreasing rapidly with falling temp. to 0.5% at 440° . Addition of La to Mg causes an increase in the Brinell hardness on tempering the quenched metal for a short time at 300° . The electrical resistance of Mg and of Mg-Al alloys is little changed by La, and at the higher concns. (2—4%) is < that of pure Mg and of the La-free alloy respectively. On the other hand addition of Al considerably increases the resistance of Mg. F. L. U.

Solubility of methane in cyclohexane. E. P. Schoch, A. E. Hoffmann, and F. D. Mayfield (*Ind. Eng. Chem.*, 1940, **32**, 1351—1353).—Using the method described previously (A., 1940, I, 319), sp. vol. and bubble-point pressure data have been obtained for various mixtures of CH₄ and cyclohexane (11.75—73.85% CH₄) at 100.27°, 160°, and 220° f. J. W. S.

Equilibrium solutions of lactose-salt mixtures. O. G. Jensen, Z. M. Hanford, and G. C. Supplee (*J. Dairy Sci.*, 1940, **23**, 745—753).—Solubilities of lactose in 24 salt solutions are given. Certain salts increase the solubility by forming complexes. J. G. D.

Cane molasses. II. Solubility of sugars in aqueous salt solutions. K. A. N. Rao and G. N. Gupta (*J. Indian Chem. Soc.*, *Ind. Edit.*, 1940, **3**, 49—51).—The quantities of sucrose, glucose, and fructose dissolved by 5% aq. solutions of

numerous salts, and of sucrose and glucose dissolved by 10% salt solutions, are recorded. I. A. P.

Reduction by activated charcoal of silver ions from aqueous solutions in the presence of alcohols. M. S. Belenki and L. I. Kovaleva (*Kolloid. Shurn.*, 1939, **5**, 219—224).—Charcoal was washed out with dil. HNO₃ and shaken with aq. AgNO₃ the concn. of which was determined before and after contact with C. The amount of Ag adsorbed and reduced is lowered by alcohols; higher alcohols (up to C₆H₁₃-OH) are more effective than EtOH and PrOH. The alcohols are adsorbed by C as shown by an increase in the surface tension. J. J. B.

Theory of non-dissolving volume (negative adsorption). B. A. Derjaguin (*Kolloid. Shurn.*, 1939, **5**, 257—261).—Negative adsorption takes place when solvent mol. are more strongly attracted by the adsorbent than the mol. of solute. It should increase when the vol. of the mol. of solute increases. A possible change of it with dilution is calc. J. J. B.

Colloid chemistry of high temperatures. III. Adsorptive capacity of thermally desolvated clays. S. I. Djatschkovski and A. J. Gurvitsch (*Kolloid. Shurn.*, 1939, **5**, 271—276).—A clay was used either without heat-treatment (I), or after boiling with H₂O for 4 hr. (II), or after heating with H₂O at 150° (III). The adsorption of fuchsin and methylene-blue from aq. solutions increases from (II) to (I) to (III). Adsorption of NH₃ gas by (I) is > by (III). The change produced by heating to 150° is termed "de-solvation." J. J. B.

Adsorption accompanied by chemical reaction. A. V. Snamenski (*Kolloid. Shurn.*, 1938, **4**, 631—639).—The amount of NaOH taken up by cotton from a solution of concn. c is $\propto c^2$, a result which is accounted for if it is supposed that Na-cellulose is formed and at the same time NaOH is adsorbed according to the Freundlich isotherm. Mercerised cotton sorbs more NaOH than unmercerised cotton. For the sorption of H₂C₂O₄ by Fe(OH)₃, $q_1 q_2 \propto c^2$, where q_1 is the amount adsorbed by 1 g. of adsorbent and q_2 the amount of H₂C₂O₄ reacting chemically with the Fe(OH)₃. R. C.

Importance of polarity of medium for adsorption of substances by composite briquetted adsorbents. N. F. Jermolenko and L. J. Rabinovitch (*Kolloid. Shurn.*, 1939, **5**, 5—11).—Filter-paper was soaked in water-glass, treated with HCl, and briquetted under the pressure p . The briquettes were carbonised at 700° and used as adsorbents. The adsorptive capacity decreases when p increases from 500 to 2300 kg. per sq. cm. The adsorption of picric acid from mixed solvents increases when the % of C₆H₆ in a mixture with CCl₄, or of EtOH in aq. EtOH, decreases. There is a weak min. at 25 vol.-% of C₆H₆ in its mixtures with EtOH and CHCl₃. The adsorption by charcoal shows a min. at 25 vol.-% of C₆H₆, and that by SiO₂ a max. at 75% of C₆H₆ in C₆H₆-EtOH mixtures. J. J. B.

Importance of constitutional properties of organic acids for their adsorption from mixed solvents. N. Jermolenko and D. Ginsburg (*Kolloid. Shurn.*, 1939, **5**, 263—270).—The adsorption on wood charcoal of CH₂Cl-CO₂H (I), CHCl₂-CO₂H (II), and CCl₃-CO₂H (III) is from CCl₄ > from H₂O > C₆H₆ > EtOH; in C₆H₆ and EtOH the adsorption of (III) > (II) > (I), and in H₂O and CCl₄ that of (I) > (II) > (III). The adsorption from EtOH-C₆H₆ mixtures has a min. approx. corresponding with the max. of the mol. polarisation; no singular points are present in the curves for other solvent mixtures. For AcOH the order is H₂O > CCl₄ > C₆H₆ > EtOH, for *o*-OH-C₆H₄-CO₂H H₂O > CCl₄ > C₆H₆ > EtOH > COMe₂, and for *m*-NH₂-C₆H₄-CO₂H H₂O > EtOH. The adsorption of *o*-OH-C₆H₄-CO₂H shows a min. in COMe₂-C₆H₆ mixtures but none in other mixtures. J. J. B.

Calculation of surface tension from intermolecular forces. J. E. Lennard-Jones and J. Corner (*Trans. Faraday Soc.*, 1940, **36**, 1156—1162).—The general relations between γ and intermol. forces are discussed, using $\phi_0\{(\frac{r_0}{r})^{12} - 2(\frac{r_0}{r})^6\}$, where ϕ_0 and r_0 are const., for the intermol. potential. Adopting the theory of liquid structure previously developed (cf. A., 1939, I, 385 and previous abstracts), it is shown that certain empirical laws (e.g., Eötvös') can be deduced theoretically. The properties of the parachor are examined and $[P]$ is shown to be proportional to the intermol. field const. by the expression $[P]\phi_0^{-1}r_0^{-2} = \text{const.}$ F. L. U.

Anomalous osmosis. K. Sollner and I. Abrams (*J. Gen. Physiol.*, 1940, **24**, 1—5).—Phenomena of anomalous osmosis,

such as those described by Loeb, cannot be obtained with membranes made from relatively pure collodion (I), but positive effects are observed if the (I) contains acidic impurities. Large anomalous effects are obtained when the inactive (I) has been treated with NaOBr. D. M. N.

Scattering of light by coarse aerosols. I. L. V. Smirnov. II. L. V. Smirnov and N. M. Bashenov (*Kolloid. Shurn.*, 1938, 4, 717—723, 745—748).—I. The variation of light scattering, I , with λ for coarse mists of Solar oil and glycerol is represented by $I \propto \lambda^\alpha$, where $\alpha > 0$. This observation accords with calculations based on Mie's theory.

II. The general conditions for the validity of the above equation have been worked out; for a Solar oil mist the particle radius must lie between 0.4 and 0.7 μ , which agrees with experiments. R. C.

Preparation of paraffin emulsions by magnetostrictional vibrations. S. S. Tumanski (*Kolloid. Shurn.*, 1939, 5, 105—110).—A Ni-tube vibrator was used at a frequency of 4000—20,000 cycles. Pure paraffin oil gave 6% emulsions in H_2O which broke within a few days. Stable emulsions of 10 g. of oil in 100 g. of H_2O were prepared in presence of 8 g. of α -diethylamino- β -oleamidoethane ("sapamine MS") or of 3 g. of gelatin. The rate of prep. decreases when the intensity of the supersonic field increases; the frequency has no effect. J. J. B.

Dispersion of metals in liquids by supersonic field. L. N. Solovieva (*Kolloid. Shurn.*, 1939, 5, 289—297).—A quartz oscillator vibrating 4×10^8 times per sec. was used. The loss of wt. of plates subjected to supersonic field in H_2O increased in the order $Cu < Al < Ni < Sn < Pt < Au < Cd < Zn < Mg < Bi < Pb$; Zn, Mg, and Pb formed hydroxides. In paraffin oil only Bi, Pb, and Cd could be dispersed. Addition of 0.2% of Na oleate lowered the dispersion in H_2O ; addition of oleic acid (up to 100%) or stearic acid (up to 5%) to paraffin oil strongly increased the dispersion of Pb. The dispersion of Pb in H_2O is strongly reduced by sugar and Bu^x xanthate and is not affected by saponin; 0.1% of Na oleate reduces it more than 1% of Na oleate. A tentative explanation of these observations is advanced. J. J. B.

Formation and crystallisation of colloidal calcium sulphate. P. P. Budnikov and D. P. Bobrovnik (*Kolloid. Shurn.*, 1938, 4, 483—495).— $CaSO_4$ sol has been prepared by interaction of $CaCl_2$ and H_2SO_4 in MeOH solution. The crystallisation of $CaSO_4 \cdot 2H_2O$ on addition of H_2O to the sol was followed by η measurements, parallel measurements being made with $CaSO_4 \cdot 2H_2O$ suspensions. The nature of the crystals produced was examined microscopically. Inorg. acids promote crystal growth. An aq. extract of peat accelerates the sol-gel change and the formation of crystal nuclei, but retards the growth of these nuclei, so that the final product consists largely of crystals of sub-microscopic size. R. C.

Ageing of sols and gels. V. Influence of electrolytes on the formation of sols of mercury acetamide. E. M. Preis and M. A. Nikolaeva (*Kolloid. Shurn.*, 1939, 5, 169—174; cf. A., 1937, 361).—Sols of $(NH_4)_2Hg$ (I) gelate in presence of nitrates, oxalates, or acetates, and the pH of the sol (measured with a glass electrode) does not change in the course of gelation. KCl, KBr, KI, KCNS, and $Na_2S_2O_3$ when mixed with (I) liberate alkali, the amount of which is equiv. to the (I) present. If insufficient amounts of salts are used the amount of alkali liberated increases in the series $KCl < KSCN < KBr < Na_2S_2O_3 < KI$. The lyotropic series also applies to reactions between truly dissolved substances. J. J. B.

Effect of acetic acid and acetate buffers on structure of aluminium hydroxide sols. Z. I. Aristova (*Kolloid. Shurn.*, 1938, 4, 671—677).—AcOH peptises, η falling steadily. With a buffer of pH 3.2 η increases with time, and the coagulating action of the OAc^- ion predominates over the peptising action of AcOH. With rise in pH the coagulating action increases, but passes through a max. with time, suggesting thixotropy. The PO_4^{3-} ion has a powerful coagulating action even at low concn. R. C.

Chemical factors influencing development of structure in and stability of aluminium hydroxide sols. I. Effect of heating. II. Effect of neutral salts and caustic alkalis on development of structure. E. I. Kviat (*Kolloid. Shurn.*, 1938, 4, 551—560, 621—629).—I. When these sols are heated η and the stability fall, and the structural branch on the pH - η

curve, where t is the time of flow through an Ostwald viscometer under pressure p , becomes less marked. These seem to be consequences of olation and oxolation (cf. Stiasny and Grimm, B., 1928, 24). The pH also falls, owing to hydrolysis both on the surface of the micelles and within the solution. As sols which have not been boiled age at room temp. the pH usually falls; with sols which have been boiled the reverse is true, due to deolation, but the pH -time curve differs considerably from that for $Fe(OH)_3$ sols, for which hydrolytic effects apparently outweigh olation.

II. The structures developed in sols may be "extended" or "compact." The former type are loosely constructed and increase η considerably and their development leads to gelation, whilst compact structures do not give rise to a structural branch on the pH - η curve. In certain circumstances one type of structure may change into the other. Heating, ageing, or addition of electrolytes leads to the formation of both types of structure. Addition of neutral salts or caustic alkalis to $Al(OH)_3$ sols promotes development of structure to an extent depending on the age of the sol, its previous thermal history, and the temp. at which the mixture is heated. The rate of structure development increases with age, and is influenced by the wall of the containing vessel. The behaviour of undialysed $Al(OH)_3$ sols containing alkali resembles that of $Fe(OH)_3$ sols. R. C.

Colloid-chemical investigation of the Chasov Yar clay No. 5. E. A. Shuragina and S. E. Charin (*Kolloid. Shurn.*, 1939, 5, 175—183).—When clay is saturated with various cations and dialysed the % of particles below 1 μ . increases in the series Ca -clay $< H^-$ native clay $< K^-$ $< NH_4^+$ $< Na$ -clay. The opacity of a 0.1% suspension is high for Na^+ , NH_4^+ , and K^+ -clays, and low for native and H^- -clay. The rate of electro-osmosis of H_2O through a clay membrane increases in the order Ca^- $< H^-$ native $< NH_4^+$ $< Na$ -clay. The adsorption of H_2O (calc. from the negative adsorption of KCl) is high for Na^- and K^- -clays and low for H^- -clay. The electrokinetic potential seems to be the factor determining the peptisation and stability of clay suspensions. J. J. B.

Plastic viscous properties of mica suspensions. I. S. Erochin (*Kolloid. Shurn.*, 1939, 5, 69—78).—Mica suspensions in liquid paraffin and a rotating-cylinder viscometer were used. 20% and 25% suspensions are not thixotropic and have low yield point. In 30—40% suspensions η is reduced by rotating the cylinder and increased again by stirring; the yield point is high. It is calc. that in 30% suspension the mica particles ($0.1 \times 0.01 \times 0.001$ mm.) are surrounded by "immobilised" oil layers 3 μ . thick; this is the min. thickness at which the structural part of η becomes important. J. J. B.

Viscosity of thorium arsenate gels during setting. M. Prasad and B. G. Shejwalkar (*J. Indian Chem. Soc.*, 1940, 17, 508—514).—The viscosity (η) of Th arsenate gel-forming mixtures $[Th(NO_3)_4 + HAsO_4]$ increases with time, slowly at first, then rapidly, and finally in many cases reaches limiting vals. The η after a certain time is decreased by increase in $[Th(NO_3)_4]$ in the mixture, addition of non-electrolytes (alcohols or glycerols), or rise of temp., but is increased by increase in the $[HAsO_4]$ or by addition of electrolytes (KCl or $BaCl_2$). The results confirm that the sol \rightarrow gel transformation is a continuous process. J. W. S.

Four-component systems. M. Cholodova (*Kolloid. Shurn.*, 1938, 4, 507—509).—The appearance of $Fe(OH)_3$ sols containing EtOH and succinic, malic, tartaric, or citric acid is described. R. C.

Structural properties of ferric hydroxide sols. E. I. Kviat (*Kolloid. Shurn.*, 1939, 5, 225—233).—The viscosity of a well-dialysed $Fe(OH)_3$ sol with pH 3.7 was low and little affected by boiling for 1 hr. That of a $Fe(OH)_3$ sol containing much $FeCl_3$ and having pH 2.9 was high; it increased tenfold on boiling and then slowly decreased; it was also anomalous. Whilst HCl had almost no effect on dialysed $Fe(OH)_3$ it reduced the η of the other sol. The η of the undialysed sol was at first lowered by alanine, but after 4 days was increased above that of the original sol. In dialysed sols heating increases the "olation" (second stage of hydrolysis). Alanine, which forms complexes with Fe, destroys the "ol" compounds. J. J. B.

Mol. wts. of rubber and related materials. I. Experimental methods. II. Osmotic pressure and viscosity of solu-

tions of raw rubber. G. Gee (*Trans. Faraday Soc.*, 1940, **36**, 1163—1171, 1171—1178).—I. The construction and operation of a new osmometer, and a method of determining v.p. lowering from the rate of isothermal distillation of solvent into a solution, are described. The interpretation of the results is discussed. Staudinger's η -mol. wt. relationship is examined and criticised.

II. Osmotic pressures of various kinds of raw rubber dissolved in $C_6H_{11}OAc$, C_6H_6-MeOH , and C_6H_6-EtOH have been measured and used to calculate the mol. wt. A poor solvent or a mixture of solvent with precipitant gives solutions which approach ideal osmotic behaviour. Mol. wts. are also calc. from η measurements by Staudinger's law, which is valid for rubber solutions over the mol. wt. range 350,000—60,000. The osmotic and η methods agree for rubber fractions, whilst for unfractionated material the η method gives higher average vals. The mol. wt. of "sol" rubber is $>$ that of "gel"; hence the sol-gel separation does not arise from difference of mol. wt. F. L. U.

Method of determination of the rate of swelling and dissolution of highly polymerised substances. T. I. Jurshenko (*Kolloid. Shurn.*, 1939, **5**, 147—152).—The vol. displaced by a swelling specimen is determined from time to time. For Na divinyl rubber in C_6H_6 it first increases and then, because of incipient dissolution, decreases. The dissolution is completed the more rapidly the higher is the plasticity no. of the rubber. J. J. B.

Structure of water envelopes of hydrophilic colloids. Z. Tschescheva and M. Kolesova (*Kolloid. Shurn.*, 1938, **4**, 497—505).—The ζ -potential and hydrophilic nature, measured by their power of adsorbing H_2O from glucose solutions, of various kinds of starch containing Na, Al_2O_3 , and Pb tartrate have been determined. The results are interpreted in relation to the hydration of the ions and chemisorption by the starch surface. R. C.

Behaviour of cellulose in alkaline solutions.—See B., 1940, 848.

Changes in viscosity of cellulose nitrate sols. IV. Gelation of sols. A. V. Pamfilov, A. G. Schicher, and M. G. Schicher. V. Scheme of gelation. A. V. Pamfilov and M. G. Schicher (*Kolloid. Shurn.*, 1938, **4**, 569—585, 587—591).—IV. The gelation of sols of cellulose nitrate (I) in presence of Cu (A., 1936, 795) is accelerated by the presence of NO and N_2O_3 and is the more rapid the less stable is the (I). Cu_2O increases η , but Cu^{II} salts have little effect. PbO , Pb_2O_4 , and, in certain circumstances $Pb(OAc)_2$ have a marked gelating action. Sols prepared with stabilised (I) and solvents free from acid impurities gelate very slowly or not at all in presence of Cu or PbO . The presence of NH_4Ph_2 delays gelation considerably. Cu does not affect η of acetyl-, benzyl-, and ethyl-cellulose sols.

V. The above gelation is probably due to hidden coagulation rather than to compound formation. R. C.

Viscosity of cellulose triacetate solutions.—See B., 1940, 848.

Dielectric properties of cellulose derivatives in organic liquids.—See B., 1940, 849.

Tearing strength of agar gel. P. S. Shelezkov (*Kolloid. Shurn.*, 1938, **4**, 523—531).—The tearing strength, P_n , of a gel of concn. n is given by $P_n/P_{n-a} = K$, where P_{n-a} is the strength of a gel of concn. $(n-a)$ and K is a const. for a given val. of n . If a gel prepared from an acid sol is heated at a given temp., θ , the strength after time t is given by $P/P_{t+a} = k$, where P_{t+a} is the strength after heating for a time $(t+a)$ and k is a const. depending on d , and rising with θ and the acidity. The results indicate that 75° is the optimum temp. for the pasteurisation of fruit jellies made with agar. R. C.

Swelling of pectins. T. K. Gaponenkov (*Kolloid. Shurn.*, 1938, **4**, 641—645).—The swelling of various pectic substances from sugar-beet and the heats of swelling in $EtOH-H_2O$ mixtures have been measured. $EtOH$ hinders the osmotic abstraction of H_2O from these mixtures, but hydration proceeds even at high $[EtOH]$. The heat of dissolution of araban in H_2O is almost wholly accounted for by the union of a H_2O mol. with each OH group of the solute. R. C.

Peptising effect of heat-treated gelatin. I. I. Sokolov (*Kolloid. Shurn.*, 1939, **5**, 111—124).—The coeff. of diffusion D of KCl in 3% gelatin (I) gel at 18° was 2.2×10^{-6} , and in 3%

gel of 99% of (I) + 1% of thermolysed gelatin (II) 3.1×10^{-6} sq. cm. per sec., showing that thermolysis products loosen the gel structure. The thermolysis was carried out at 100° for 60 hr. D of (I) in H_2O was 0.09 and that of (II) 0.27 sq. cm. per day, whilst D of 0.3% (I) into 0.25% (II) was 0.10 sq. cm. per day. It is concluded that sol. fractions of (I) peptise its insol. fractions. J. J. B.

Influence of ultra-frequent electric field on some physico-chemical properties of colloids. N. P. Sinitzin (*Kolloid. Shurn.*, 1939, **5**, 305—313).—Gelatin kept in the alternating field ($\nu = 50,000$) of a condenser suffers no observable change in isoelectric point, swelling, m.p., i.p., pH , optical activity, n , or X-ray pattern. The field intensity was 50—200 v. per cm. J. J. B.

Micellar changes in ageing gelatin sols and gels. I. Bulankin (*Kolloid. Shurn.*, 1938, **4**, 657—670).—With increasing age of gelatin (I) gels kept at 20°, the power of mutarotation passes through a max., which depends on the concn., c , and falls to a const. val., also depending on c . With (I) aged at 35° the power of mutarotation falls from the outset. The above max. corresponds with a min. surface tension, suggesting that the initial rise in the power of mutarotation is due to diminishing electrostatic solvation of the micelles. The next stage of ageing is characterised by a gradual loss in structural properties, as revealed by the declining power of mutarotation, and at the same time the $EtOH$ no. increases and there is depolymerisation of the (I). From the constancy of the true sp. rotation at 35° and the relatively slight variation in NH_2-N it is inferred that ageing does not involve any profound chemical changes in the mol., but depends rather on dissociation of the micelles. R. C.

Structure and physicochemical properties of disaggregated gelatin. I. I. Sokolov (*Kolloid. Shurn.*, 1938, **4**, 533—549).—Heated gelatin sols lose their power of forming gels a little before η has fallen to a const. val. The brightness of the Tyndall cone is weakened by heating. The sp. rotation of disaggregated gelatin (I) varies little with temp., and at higher temp. is $>$ that of normal gelatin (II). (I) has its isoelectric point at pH 4.4. From the absorption spectra of (I) and (II) in the visible and ultra-violet it appears that disaggregation entails a change in mol. structure. The polarograms show that (I) and (II) behave identically on electrolysis. If (II) is subjected to ultrasonic radiation from a magnetostrictive vibrator η falls and the ability to form a gel disappears. These observations agree with the theory that in the disaggregation of gelatin the polypeptide chains remain intact, but form some kind of cyclic structure. R. C.

Effect of ultra-violet radiation on gelatin films. S. A. Reitlinger (*Kolloid. Shurn.*, 1938, **4**, 679—687).—The swelling power and solubility fall, the η of the solution rises, and the heat of swelling and X-ray diagram are not affected. With films of thermolysed gelatin the time of irradiation required to produce the insol. form (I) increases with the duration of thermolysis. It is suggested that the transformation of gelatin into (I) consists in the formation of three-dimensional aggregates of the polypeptide chains by reaction of NH_2 and CO_2H groups of the side-chains. The formation of such cross-linkings would oppose swelling. R. C.

Effect of Congo-red on coagulation of animal albumins by copper salts. I. B. S. Putschkovski (*Kolloid. Shurn.*, 1938, **4**, 561—567).—Congo-red (I) sensitises ovalbumin to pptn. by $CuSO_4$, and the effect in acid solution is $>$ in absence of acid, apparently owing to the liberation of Congo-blue (II) by the acid. There is evidence that albumin reacts with (I) and (II). R. C.

Periodic structures. I. Periodic structures formed by evaporating solutions of nitrates. P. F. Michalev (*Kolloid. Shurn.*, 1938, **4**, 725—727).—Structures obtained by evaporating solutions of nitrates and ferrocyanides are described. R. C.

Laminar coagulation of colloidal ferric hydroxide. N. Jermolenko and G. N. Plenina (*Kolloid. Shurn.*, 1939, **5**, 193—199).—A slightly alkaline solution of lupin proteins was mixed with $Fe(OH)_3$ sol and made to foam. The amount of Fe found in the foam increases linearly with $[Fe(OH)_3]$ and is almost independent of the vol. of air used to produce the foam. It is suggested that protein and $Fe(OH)_3$ form in the foam lamellae a two-dimensional thixotropic gel. J. J. B.

VI.—KINETIC THEORY. THERMODYNAMICS.

Complex ion in solutions containing manganese and ammonium salts. R. I. Agladze (*J. Gen. Chem. Russ.*, 1940, 10, 340—346).—The p_H of aq. $MnCl_2$ is lowered by addition of aq. NH_4Cl ; this is ascribed to the reaction $MnCl_2 + nNH_4Cl \rightleftharpoons [Mn(NH_4)_n]Cl_2 + nHCl$. The existence of the complex ion $[Mn(NH_4)_n]$ is supported by the exceptionally high buffering capacity of the systems $MnCl_2-NH_4Cl-H_2O$ or $MnSO_4-(NH_4)_2SO_4-H_2O$, by the non-pptn. of $Mn(OH)_2$ in presence of NH_4 salts, and by the flatness of the polarisation curves obtained in electrolysis of Mn salts in presence of NH_4 salts.

R. T.

Metalloporphyrins.—See A., 1940, II, 383.

Thermodynamic study of bivalent metal halides in aqueous solution. V. Activity coefficients of cadmium chloride and bromide at 25°. R. A. Robinson. VI. Activity coefficients of manganese, cobalt, nickel, and copper chloride in aqueous solution at 25°. R. A. Robinson and R. H. Stokes (*Trans. Faraday Soc.*, 1940, 36, 1135—1136, 1137—1138; cf. A., 1940, I, 359).—V. Data are recorded for the concn. range 0.1—6.0M. VI. Data are recorded for the concn. range 0.1—2.8M.

F. L. U.

Activity of metals in binary systems showing marked departure from ideal behaviour. K. Hauffe (*Z. Elektrochem.*, 1940, 46, 348—356).—Activities and activity coeffs. of the component metals have been determined by measuring the e.m.f. of cells of the type $M + Na | glass | Na$. Liquid Hg—Na and Cd—Na alloys were used in the temp. range 300—395°. The vals. of f_{Na} and f_{Hg} obtained are supplemented by vals. deduced from published v.p. data. In the Hg—Na system the vals. of $RT \log_e f$ are nearly independent of temp. in the range 300—375°, and are therefore approx. equal to the partial mol. heats of mixing of the respective metals. The results in the system Cd—Na are in harmony with the existence of a liquid-miscibility gap as found by Mathewson (A., 1906, ii, 666) in the range Na 60—70 at.-%. In the system Hg—Sn vals. of $RT \log_e f$ are calc. from v.p. and thermal data; the curves obtained by plotting these vals. against the mol. fraction are similar to those found for Hg—Na.

F. L. U.

Gas-liquid equilibrium constants. Methane-decane system.—See B., 1940, 828.

Equilibrium curves and boiling and condensation lines of ethyl alcohol-water mixtures under reduced pressures. E. Kirschbaum and F. Gerstner (*Z. Ver. deut. Ing. Beih. Verfahrenstechn.*, 1939, 10—15).—Data obtained with a new type of apparatus are presented. Equilibrium curves for abs. pressures of 50, 100, 250, 500, and 740 mm. Hg are deduced from the boiling and condensation lines.

R. B. C.

Reduction equilibrium of ferrous oxide in liquid iron by hydrogen. I. Tajiri and Z. Shibata (*Tetsu-to-Hagane*, 1939, 25, 194—197).—The equilibrium const. of the reaction FeO (dissolved in Fe) + $H_2 \rightleftharpoons Fe + H_2O$ was determined by passing H_2-H_2O mixtures over the metal at 1545—1700° and determining the residual FeO ; $\log K = 6612/T - 3.55$. For reduction of the FeO by CO within the same temp. range $\log K = 7978/T - 4.88$.

A. R. P.

Ternary system potassium nitrate-ammonium nitrate-water at 25°. R. K. Bahl and S. Singh (*J. Indian Chem. Soc.*, 1940, 17, 441—442).—No double salts or salt hydrates occur in this system at 25°.

J. W. S.

Equilibrium relations of system $NaCl-NH_4HCO_3-NaHCO_3-NH_4Cl-H_2O$ under high pressures of carbon dioxide.—See B., 1940, 856.

Heat of hydration of the proton. E. C. Baughan (*J.C.S.*, 1940, 1403).—A recalculation of the heat of hydration of the proton using the latest data for the heats of hydration of halogen ions gives an average val. 282.5 ± 3 kg.-cal.

C. R. H.

VII.—ELECTROCHEMISTRY.

Electric conductivity of thin films of copper sulphide. V. A. Kosheurov (*Kolloid. Shurn.*, 1939, 5, 45—61).—Films were prepared by passing 2% H_2S over solutions of $CuSO_4$ or $Cu(NO_3)_2$. They reached in 10—15 sec. the final thickness of 160—210 Å. Their sp. resistance ρ was $1.5-1.7 \times 10^{-2}$ ohm cm. It increases many times in a vac. and also in air on heating. Slow cooling after slow (several hr.) heating to 100° also

raises ρ ; a real temp. coeff. of ρ does not exist. Heating to 200° in S vapour does not affect ρ but changes the colour of the film from brown to green. Presumably the films are Cu_2S ; their relatively high conductivity is due to the presence of S which evaporates at high temp. or in a vac. J. J. B.

Effect of sucrose on transport number, conductivity, viscosity, and $[H^+]$ of solutions of hydrochloric acid. I. I. Shukov and G. F. Dneprov (*J. Gen. Chem. Russ.*, 1940, 10, 291—294).—At 25—35° the val. of the transport no. of Cl^- is unaffected by up to 20% of sucrose in 0.1N-HCl, but falls steadily as the concn. exceeds 20%. Conductivity and p_H fall, and d rises, with increasing sucrose concn., whilst η rises very gradually up to 50% sucrose, and steeply as this concn. is exceeded.

R' T.

Transport numbers of zinc chloride from e.m.f. measurements. A. C. Harris and H. N. Parton (*Trans. Faraday Soc.*, 1940, 36, 1139—1141).—The e.m.f. of the cells $Zn | Hg | ZnCl_2(m_1) | AgCl(s) | Ag$ and $Ag | AgCl(s) | ZnCl_2(m_2) | ZnCl_2(m_1) | AgCl(s) | Ag$ were measured at 25° and 35° over the concn. ranges 0.5—12.0 and 0.5—9.0M. respectively. Calc. vals. of the transport no. u_z are tabulated. u_z becomes negative above 2M. (cf. A., 1939, I, 419).

F. L. U.

Decomposition potentials of lithium chloride, potassium chloride, and magnesium chloride. H. Grothe and W. Savelsberg (*Z. Elektrochem.*, 1940, 46, 336—346).—Potential-c.d. curves are given for molten LiCl, KCl, and $MgCl_2$, and for LiCl-KCl and ternary mixtures, at various temp. between 600° and 900°. The decomp. potentials at 800° (temp. coeff. in parenthesis) are: LiCl 3.17 (1.67 $\times 10^{-3}$), KCl 3.10 (1.72 $\times 10^{-3}$), $MgCl_2$ 2.49 v. (1.21 $\times 10^{-3}$). The single potentials of the metals, calc. for 20°, are: Li —2.96, K —3.10, Mg —2.08 v.

F. L. U.

Polarisation of redox electrodes. V. Čupr (*Z. Elektrochem.*, 1940, 46, 364—368).—An expression is derived giving the relation between the strength of the polarising current and the polarisation of an electrode the potential of which is determined by the concns. of two components forming a redox system in the solution. The relation is approx. linear when the polarisation is >0.02 v.

F. L. U.

Rate of dissolution of metals in acids as a function of over-voltage. I. Diffusion potential. II. Dissolution of cadmium in sulphuric acid. G. E. Kimball and A. Glassner (*J. Chem. Physics*, 1940, 8, 815—820, 820—827).—I. Mathematical. Simultaneous conduction and diffusion through a constrained diffusion layer is discussed. An exact solution is obtained for an ideal dil. solution containing two ionic species, and a numerical solution of the case of bivalent ions diffusing into a uni-bivalent electrolyte. For diffusion layers $\sim 50 \mu$ thick the p.d. across the layer for currents of 100 ma. per sq. cm. is <1 mv., so the diffusion potential can be neglected in comparison with the double layer potential.

II. The rate of dissolution (v) of Cd in H_2SO_4 is const. at a given potential and independent of the $[H_2SO_4]$. It increases with increasing electrode potential in accord with the theory of Kimball (A., 1940, I, 223). From the variation of v with the speed of stirring and with the electrode potential it is inferred that the dissolution process is controlled by diffusion.

J. W. S.

VIII.—REACTIONS.

Reaction of hydrogen atoms with butane. E. W. R. Steacie and E. A. Brown (*J. Chem. Physics*, 1940, 8, 734—738).—The reaction of H atoms with C_4H_{10} has been studied at 35—250°. The activation energy is 9 ± 1.5 kg.-cal. per mol. At low temp. the sole product is CH_4 , but at higher temp. C_2H_6 is also formed. The results indicate a mechanism in which a series of at. cracking reactions plays the main rôle, and it is suggested that the primary process is $H + C_4H_{10} \rightarrow C_4H_9 + H_2$, followed by further reactions of C_4H_9 with H, whereby smaller free radicals are produced, the CH_3 , and at higher temp. also the C_2H_5 , radicals finally reacting with a H_2 mol. to form CH_4 and C_2H_6 , respectively.

J. W. S.

Application of the theory of absolute reaction rates to heterogeneous processes. I. Absorption and desorption of gases. II. Chemical reactions on surfaces. K. J. Laidler, S. Glasstone, and H. Eyring (*J. Chem. Physics*, 1940, 8, 659—667, 667—676).—I. By means of the theory of abs. reaction rates and by regarding adsorption as involving reaction between a gas mol. and an adsorbing centre, equations are

derived for the rates of adsorption and desorption of gases. Combination of these equations gives an adsorption isotherm similar to that of Langmuir. The rate equations and adsorption isotherms for cases in which adsorption is accompanied by dissociation or interaction between the adsorbed mols. are discussed. Equations are also derived for adsorption on covered surfaces.

II. The theory is used to derive equations for the rates of unimol. and bimol. heterogeneous gas reactions under various conditions of covering of the surface. Combined with the energies of activation of the respective reactions these lead to vals. of the rates of decomp. of PH_3 , HI , N_2O , and NH_3 , interaction between NO and O_2 , and CO and O_2 , and dissociation of H_2 into atoms which are in accord with observed vals. It is suggested that adsorption of the activated complex lowers the overall activation energy of a reaction, and hence favours the surface reaction as compared with the homogeneous reaction. If a product or other substance acting as a poison is strongly adsorbed the activation energy is increased, but some compensation arises from the increase in entropy accompanying the desorption of the poison.

J. W. S.

Mechanism of reactions involving excited electronic states. Gaseous reactions of the alkali metals and halogens. J. L. Magee (*J. Chem. Physics*, 1940, 8, 687—698).—Theoretical. The possibility of restriction of the change from homopolar to heteropolar state, or vice versa, during reaction between alkali metals and halogens is discussed, and it is concluded that serious restriction can occur only for interat. reactions. The possibility of the formation of excited alkali metal atoms during these reactions is also discussed.

J. W. S.

Directed valency in chemical reactions. J. L. Magee (*J. Chem. Physics*, 1940, 8, 677—687).—Theoretical. The potential energy surfaces for reactions of 2 H atoms in S states with another atom having a single valency electron in a 2p orbital are derived. The activation energies (E) calc. for the reactions $\text{H}_2 + \text{X} \rightarrow \text{H} + \text{HX}$ ($^1\Sigma$) and $\text{HX} (^1\Sigma) + \text{H} \rightarrow \text{H} + \text{XH} (^1\Sigma)$ (X = atom with electron in 2p orbital) are ~ 1 kg.-cal. per mol., in accord with the vals. observed when X = halogen and with the principle that directed valency decreases E . The symmetrical configurations for the complex H_2X have the lowest energy and are stable with respect to dissociation into either $\text{HX} + \text{H}$ or $\text{H}_2 + \text{X}$. The mechanism of the reaction between H_2 and halogens is discussed.

J. W. S.

Sedimentation analysis of nickel catalyst.—See B., 1940, 872.

[Hydrogenation] catalysts from alloys; nickel catalysts.—See B., 1940, 841.

Hydrogenation. Rôle of the catalyst.—See B., 1940, 841.

[Catalytic] hydrogenation of aniline.—See B., 1940, 842.

[Catalytic] hydrogenation of petroleum.—See B., 1940, 836.

Theory of the potential and technical practice of electro-deposition.—See B., 1940, 867.

Quantitative electrodeposition of tin from chloride solutions.—See B., 1940, 867.

Electrolytic polishing of stainless steels.—See B., 1940, 865.

Relation between Kolbe's reaction and hydrogen-ion concentration. VIII. R. Matsuda and S. Ikuta (*Bull. Chem. Soc. Japan*, 1940, 15, 322—331; cf. A., 1932, 1214).—Data are recorded for the anodic gas composition and the current efficiency in the electrolysis of solutions containing various proportions of H_2SO_4 , $(\text{NH}_4)_2\text{SO}_4$, AcOH , and NH_4OAc . From all solutions containing free acid O_2 is evolved in quantities increasing with the acidity. CO_2 is always produced, and CO except from neutral solutions. A gas having the composition C_2O_4 is stated to be formed in small quantity from solutions that are acidic and that also produce C_2H_6 .

F. L. U.

Electrolytic reduction of phthalic acid.—See B., 1940, 870.

Reaction between aqueous iodine and sodium formate. W. V. Bhagwat (*J. Indian Chem. Soc.*, 1940, 17, 304—307).—The rate of the dark reaction was measured in presence of various salts. With KCl , NaCl , and NH_4Cl k first increases with concn. and then falls, indicating that, whilst Cl^- is a positive catalyst, the cations retard the reaction in the order $\text{NH}_4^+ > \text{Na}^+ > \text{K}^+$. Retardation is also caused by K_2SO_4 .

KNO_3 , NaNO_3 , NH_4I , and KI . Measurements of k for the photochemical reaction in presence and in absence of KI confirm previous observations (cf. A., 1934, 156, 1078) that velocity increases less rapidly than light intensity.

F. L. U.

Photochemical after-effect in the oxalate-iodine reaction. P. S. MacMahon and B. B. Lai (*J. Indian Chem. Soc.*, 1940, 17, 429—440).—The velocity of the photochemical after-effect in the reaction between $\text{K}_2\text{C}_2\text{O}_4$ and I (in KI) (cf. A., 1937, I, 525) increases continuously with increasing time of pre-illumination. The initial velocity is equal to the rate of photochemical reaction at the instant illumination is removed, but it decreases rapidly at first and then very slowly. After several hr. the velocity is still \gg that of the normal dark reaction, this effect being the greater the longer is the initial period of illumination, and not being affected appreciably by temp. When fresh I is added in the dark to solutions of $\text{K}_2\text{C}_2\text{O}_4$ and I , decolorised by illumination, a "secondary after-effect" is obtained, the velocity of reaction being \gg that of the dark reaction and decaying with time as with the primary after-effect. This effect is diminished by increasing the time interval between decolorisation and addition of I , rise of temp., and increase in the $[\text{KI}]$. Slow photochemical reaction occurs between $\text{H}_2\text{C}_2\text{O}_4$ and I , but there is no after-effect. The final solutions obtained by complete reduction of I by $\text{K}_2\text{C}_2\text{O}_4$ do not reduce HgCl_2 , so it is inferred that the mechanism of the after-effects is not the same as in the reaction between $\text{H}_2\text{C}_2\text{O}_4$ and KMnO_4 . An explanation of the effect, based on Berthoud's chain mechanism for the reaction, is suggested.

J. W. S.

Mercury-photosensitised decomposition of ethane. IV. Reaction at high temperatures. E. W. R. Steacie and R. L. Cunningham (*J. Chem. Physics*, 1940, 8, 800—804).—The products of the reaction at 100—475° (CH_4 , C_2H_6 , and C_4H_{10}) are similar to those at low temp. (A., 1938, I, 632) and it is inferred that the mechanism is similar. The quantum yield is approx. doubled by rise of temp. from 100° to 475° and no evidence is obtained in favour of a chain reaction.

J. W. S.

IX.—METHODS OF PREPARATION.

Method for obtaining powders of uniform sodium chloride crystals in various size ranges, and the effect of size on the intensity of X-ray reflexion. F. H. Marshall (*Physical Rev.*, 1940, [ii], 58, 642—650).—The reproducible prep. of uniform crystals of any desired size in the range 1—70 μ . is effected by pptn. with abs. EtOH from a saturated aq. solution of NaCl with varying excesses of H_2O added to either of the solutions before combining them. Size range and crystal uniformity are controlled by attention to certain primary variables in the pptn. process, each producing marked changes in the character of the powder. Data for the variation with crystal size of the intensity of the 200-reflexion of $\text{Cu K}\alpha$ radiation are tabulated and plotted, showing that the intensity decreases slightly with increase of crystal size.

N. M. B.

Composition of the precipitates formed when solutions of tripotassium phosphate and magnesium chloride are mixed. A. N. Agte, P. A. Archangelski, and N. I. Birger (*J. Gen. Chem. Russ.*, 1940, 10, 295—304).—The composition of the ppts. varies from that of $\text{MgKPO}_4 \cdot n\text{H}_2\text{O}$ to that of $\text{Mg}(\text{OH})_2 \cdot 2\text{MgHPO}_4 \cdot n\text{H}_2\text{O}$ as the ratio $\text{MgCl}_2 : \text{K}_3\text{PO}_4$ rises (0.1N. solutions at 100°). $\text{Mg}_3(\text{PO}_4)_2$ is not obtained in these conditions.

R. T.

Effect of heating gypsum on its micro-structure and crystal-optical properties. V. I. Serdjukov (*J. Gen. Chem. Russ.*, 1940, 10, 359—368).—Three stages are distinguished, (i) 600—1100°, over which the d of the mass rises, but the anhydrite structure is retained, (ii) 1100—1400°, over which n rises and crystal structure changes (formation of basic sulphate), and (iii) 1400—1500° and higher, associated with fusion, and with development of a granular structure when the melt solidifies. At $>1500^\circ$ dissociation of CaSO_4 proceeds rapidly.

R. T.

Aluminium phosphate. D. P. Chatterjee (*J. Indian Chem. Soc.*, *Ind. Edit.*, 1940, 3, 85).—The prep. of a form of AlPO_4 which is insol. in mineral acids is described.

I. A. P.

Action of metals on water of crystallisation. I. Action of aluminium. II. Action of zinc. III. Structure and properties of crystal hydrates. V. I. Semischin (*J. Gen. Chem. Russ.*, 1940, 10, 319—327, 328—334, 335—339).—I. Pow-



dered Al-crystal hydrate mixtures evolve H_2 when heated at 17–200°; $\geq 51\%$ of the H_2O reacted with Al in the given conditions, and the same applied to anhyd. acids and acid salts. The reactivity of the H_2O of crystallisation rises in the orders: Mg, Ba, Sr, Ca, Al, Sn^{II} , Cd, Cu^{II} , Cr^{III} , Ni^{II} , Co^{II} , Fe^{II} ; OAc' , B_4O_7'' , S_2O_3'' , SO_4'' , SO_3'' , PO_4'' , P_2O_7'' , CO_3'' , Cl' .

II. The order of increasing reactivity for the corresponding reaction with Zn is: Ca, Sr, Mg, Ba, Cd, Cu^{II} , Mn^{II} , Cr^{III} , Sn^{II} , Fe^{II} , Al, Co^{II} , Ni^{II} ; SO_4'' , CO_3'' , SO_3'' , P_2O_7'' , B_4O_7'' , S_2O_3'' , $Fe(CN)_6''$, OAc' , Cl' . $\geq 30\%$ of the H_2O reacts, even in the case of the most reactive salt ($NiCl_2 \cdot 6H_2O$).

III. Of the 144 salts examined, 16 did not react with Mg, Al, or Zn. The reactivity of the metals falls in the order given. The results suggest that H_2O of crystallisation is partly dissociated, and has a feebly acidic function. R. T.

Reaction of hydrogen sulphide with sulphites. I. Formation of sodium dithionate by the action of hydrogen sulphide on solutions of sodium sulphite and sodium hydrogen sulphite. J. I. Zilberman and V. M. Fridman (*J. Gen. Chem. Russ.*, 1940, 10, 347–358).—The products of reaction of H_2S with aq. $NaHSO_3$ – Na_2SO_3 are $Na_2S_2O_3$ (chief product), $Na_2S_2O_8$, $Na_2S_2O_6$, and Na_2SO_4 . Production of $Na_2S_2O_3$ and $Na_2S_2O_8$ is max. with 1:1 $NaHSO_3$ – Na_2SO_3 ; that of $Na_2S_2O_6$ rises as $[NaHSO_3]:[Na_2SO_3]$ exceeds 1:1. With rising temp. (20–100°) production of $Na_2S_2O_3$, $Na_2S_2O_6$, and Na_2SO_4 falls, and of $Na_2S_2O_8$ rises. R. T.

Hydrates of chromic oxide. S. I. Djatschkovski and V. K. Rubtsova (*J. Gen. Chem. Russ.*, 1940, 10, 380–384).—Suspensions of $Cr(OH)_3$ and $Fe(OH)_3$ were exposed to temp. ranging from –182° to 240°, and were then filtered at room temp. The composition of the residues was $Fe_2O_3:H_2O = 1:1$ at –182° and –100°, 2:3 at –75°, 1:2 at –50° to –20°, 1:3 at –10° to 50°, 1:2 at 100°, and 2:3 at 150–200°; $Cr_2O_3:H_2O = 2:3$ at –100°, 1:2 at –75° to –50°, 1:5 at –20°, 1:3 at –10° to 50°, 2:5 at 100°, and 1:2 at 200°. R. T.

Reactions and exchange of active iodine in an inorganic system. S. Chatterjee and P. Ray (*J. Indian Chem. Soc.*, 1940, 17, 524–525).—When HgI_2 is added to NH_4I containing radioactive I, and the resulting $(NH_4)_2HgI_4$ decomposed by dilution with H_2O , the HgI_2 pptd. is radioactive. Similar results are obtained during the formation and decomp. of NH_4BiI_4 and $(NH_4)_2PbI_4$ so it is inferred that there is no essential difference between the normal covalency and the co-ordinate covalency in these compounds. J. W. S.

Corrosion of steels by molten nitrates.—See B., 1940, 864.

X.—ANALYSIS.

Determination of hydrogen in steel and other metals.—See B., 1940, 865.

New test for hydroxylamine by formation of "indo-oxime."—See A., 1940, II, 382.

Determination of phosphorus in titanium steels.—See B., 1940, 865.

Rapid determination of carbon in coals.—See B., 1940, 834.

Colorimetric determination of sodium hyposulphite.—See B., 1940, 845.

Spectrochemical analysis of zinc-base alloys.—See B., 1940, 866.

Spectrochemical analysis of cadmium in copper.—See B., 1940, 866.

Determination of chromium in iron and steel.—See B., 1940, 865.

XI.—APPARATUS ETC.

Abridged spectrophotometers.—See B., 1940, 828.

Variables versus constants in emission spectrography. T. A. Wright (*Amer. Soc. Test. Mat., Preprint* 112, June, 1940, 5 pp.).—The variables in the technique of spectrographic analysis are tabulated with a view to a discussion of their standardisation. R. B. C.

Glass electrode. G. E. Shaw (*Quart. J. Pharm.*, 1940, 13, 271–273).—After determination of the p_H of certain protein solutions the glass electrode frequently appears to be contaminated with a film which can sometimes be removed by repeatedly washing with distilled H_2O and finally wiping with silk. In some cases cleaning with aq. CrO_3 is necessary. It is suggested that two electrodes should be used alternately, the unused being stored in aq. CrO_3 , and a buffer check should be carried out before and after the p_H determination. J. N. A.

Simplified apparatus for electrophoresis. S. Tschalkovski (*Kolloid. Shurn.*, 1939, 5, 131–133).—The side prongs of the trident are connected with electrode vessels, and through the middle prong a pipette is introduced which touches the bottom and serves for adding the sol. J. J. B.

New technique for determining ultrasonic velocities in liquids. R. L. Narasimhaiya and C. S. Doraiswami (*Indian J. Physics*, 1940, 14, 187–189).—A method has been developed for determining the ultrasonic velocity in liquids by obtaining simultaneously the diffraction pattern over the entire region of the visible spectrum using white light. A superposed Fe arc enables the diffraction angles to be computed for a no. of standard λ . The errors arising in the determination of the focal length of the camera lens are eliminated by using a known transmission grating. In PhMe at 26.4°, and at an ultrasonic frequency of 5.689×10^6 Hz, the velocity of sound is 1314 ± 2 m. per sec. W. R. A.

Titration with a silk fibre. J. A. Linnik (*Kolloid. Shurn.*, 1938, 4, 689–697).—Owing to its isoelectric point being at p_H 5.1 a silk fibre can be used as indicator in acidimetry and alkalimetry by observing its deflexion in an electric field (cf. A., 1934, 143). R. C.

Platinised glass as a laboratory substitute for massive platinum. C. C. Coffin (*Canad. J. Res.*, 1940, 18, B, 318–321).—Platinised Pyrex glass can replace massive Pt for many purposes. A platinised Pyrex rod constitutes an electrode which is easily sealed into Pyrex apparatus. F. J. G.

Continuous vacuum distillation. M. Burger (*J. Lab. clin. Med.*, 1940, 25, 1221–1224).—A continuous vac. distillation assembly is described and illustrated. C. J. C. B.

[Lamp for use in] identification of war gases.—See B., 1940, 902.

Nomograph plotting for vapour-pressure and composition data.—See B., 1940, 828.

XIII.—GEOCHEMISTRY.

Incidence of hydrogen sulphide at Kilauea solfatarata preceding the 1940 Mauna Loa volcanic activity. J. H. Payne and S. S. Ballard (*Science*, 1940, 92, 218–219).—Apart from steam, the predominant gas, Kilauea solfatarata gases contain CO_2 85–98, SO_2 1–15, and air $\sim 1\%$. Irregular variations have occurred in the ratio $SO_2:CO_2$ during the two years under investigation. Just before and during the first few weeks of the Mauna Loa activity, traces of H_2S appeared in the solfatarata gas. L. S. T.

Loss of heat by conduction from the earth's crust in Britain. E. M. Anderson (*Proc. Roy. Soc. Edin.*, 1940, 60, 192–209).—Temp. measured at various depths in the 1007 m. Boreland Bore (*Geol. Survey Fife* 36 NIV, No. 52) are recorded. The equilibrium heat flow is calc. to be 1.28×10^{-6} g.-cal. per sq. cm. per sec. This val. agrees with those obtained in most other parts of Britain. O. D. S.

Calcite nodules in Keuper marl at Upton, Wirral. W. Schofield (*Proc. Liverpool Geol. Soc.*, 1940, 18, 4–6).—The occurrence of nodules of calcite in cavities in the marl is described, and their origin discussed. L. S. T.

Composition of the Upton nodules. J. Caspell (*Proc. Liverpool Geol. Soc.*, 1940, 18, 7–8).—The nodules described previously (cf. preceding abstract) consist of $CaCO_3$ 98.7 and $MgCO_3$ 1.3%. The host rock is composed of sand + clay 82.1, $Fe_2O_3(+Al_2O_3)$ 6.7, $CaCO_3$ 2.8, $MgCO_3$ 4.2, and H_2O 2.8, total 98.6%. L. S. T.

BRITISH CHEMICAL AND PHYSIOLOGICAL ABSTRACTS

A., I.—General, Physical, and Inorganic Chemistry

FEBRUARY, 1941.

I.—SUB-ATOMICS.

Lines of the quartet system in silver. R. N. Rai (*Sci. and Coll.*, 1936, 1, 520—521).—The first 7 pairs of terms $^2D_{5/2}$ and $^2D_{3/2}$ arising from the $4d^95s^2$ state, are classified.

CH. ABS. (c)

Breadth of the 2537 Å. mercury line in the under-water-spark spectrum. F. Asmuss (*Ann. Physik*, 1939, [v], 36, 737—752).—The half-width (w) of the line has been measured for sparks between Hg—Cd, —Sn, and —Pb alloy electrodes under H_2O , and rotating mirror photographs of the sparks have been taken. w depends largely on the [Hg] in the alloy, and since the total absorption shows a high concn. of Hg atoms in the absorbing layer the observed broadening is a pressure effect. Linear extrapolation to $p_{H_2} = 0$, with an assumed temp. of $4500^\circ K$, gives $p = 35$ atm. in the absorbing layer, but extrapolation based on Trumpy's results (A., 1927, 179) gives a more probable val. of 12 atm.

A. J. E. W.

Atomic energy values of ionised tellurium (Te II). K. R. Rao and M. G. Sastry (*Nature*, 1940, 146, 523; cf. A., 1939, I, 290).—From analysis of the spectrum of Te^+ , abs. vals. of the characteristic terms are reported. The ionisation potential of Te^+ is ~ 21.5 v., as given by the largest Te^+ term $5p^4S_{11}$.

L. S. T.

Zeeman effects in the arc spectrum of ruthenium. G. R. Harrison and J. R. McNally, jun. (*Physical Rev.*, 1940, [ii], 58, 703—708).—Measurements on resolved Zeeman patterns of 450 lines of Ru I, and term vals. and g vals. determined from the various patterns, are tabulated. When data from the various lines arising from a given term are averaged, g vals., apparently correct to ± 0.003 , are obtained for 140 terms. Results are used to extend the classification of Ru I, and to aid in the assignment of L and S vals. to highly perturbed terms. Asymmetrical patterns in lines arising from the terms y^5D_0 and y^5D_1 are discussed.

N. M. B.

Soft X-ray spectroscopy of solids. I. K - and L -emission spectra from elements of the first two periods. H. W. B. Skinner (*Phil. Trans.*, 1940, A, 239, 95—134).—The soft X-ray emission bands of Li, Be, Na, Mg, Al, B, diamond, graphite, Si, P, and S at 40—500 Å. have been systematically re-investigated with a concave-grating spectrograph connected directly to the X-ray tube; in some experiments the anti-cathode was cooled with liquid O_2 . The observed bands are considered in detail with reference to the density functions representing the at. energy levels, and a characteristic difference is shown to exist between the bands of metals and non-metals. The character of the band edges and of the "tailing" of the bands is discussed; with metals the effect of temp. on the edges is related to a Maxwellian distribution of conductivity electrons, while thermal expansion has some effect. A large broadening of the valency levels of lowest energy is proposed as a characteristic feature of the solid state. The interpretation of the bands is almost complete, and the properties of the system of levels can be deduced in detail in sp. cases. Lattice structure has a predominant effect on the nature of the bands.

A. J. E. W.

Soft X-ray spectroscopy of solids. II. Emission spectra from simple chemical compounds. H. M. O'Brien and H. W. B. Skinner (*Proc. Roy. Soc.*, 1940, A, 176, 229—262; cf. preceding abstract).— K and L emission bands were investigated for a no. of halides, oxides, sulphides, and carbides. Spectra from both atoms of the compound were recorded for SiC, BN, and a no. of oxides. The results are interpreted to give the characteristics of the bands of levels which exist for the valency electrons in the normal state of the substance.

21

For the halides data on the p - and s -levels are given; the crystal structure is found to influence the form of the bands of levels. In most oxides there is evidence of interaction between electrons in neighbouring atoms. The spectra of metal ions in oxides are very complex.

G. D. P.

Coefficient of mass intensity reduction of monochromatic X-rays for 24 elements between carbon (6) and cerium (58), for wave-lengths of 0.1279—1.433 Å. W. Wrede (*Ann. Physik*, 1939, [v], 36, 681—695).—Vals. of the coeff., μ/ρ , are measured for C, F, Mg, Al, S, Cl, Ca, Ti, V, Cr, Mn, Fe, Co, Zn, As, Se, Br, Sr, Zr, Mo, Sb, Te, I, and Ce, as elements or compounds with other light elements. The $\log(\mu/\rho)$ — $\log \lambda$ curves are straight lines for the heavier elements, but become increasingly convex towards the $\log \lambda$ axis as the at. no. (Z) decreases. The results are represented by the relation $\mu/\rho = C\lambda^n + f(\lambda)(\sigma_0/\rho)$, in which $f(\lambda) = 1/(1 + 0.048/\lambda)$. Vals. of C , n , and the classical mass scattering coeff. σ_0/ρ (which is ~ 0.2 for the lighter elements and is neglected for elements heavier than Zn) are given; C increases and n decreases with rising Z . The $\log(\mu/\rho)$ — $\log Z$ curves are linear at high λ .

A. J. E. W.

Influence of gas pressure on striking voltage of an alternating-current arc. S. Hoh and Y. Hanawa (*Electrotech. J.*, 1938, 2, 151—154; *Chem. Zentr.*, 1938, ii, 3373).—The influence of gas pressure ($p = 1$ —31 atm.) and arc current (I amp.) on the striking voltage (V) and changes of arc voltage with time has been studied with an oscillograph, using an arc between 2-mm. Cu electrodes 5 mm. apart, in air. The V — p curves have a max. ($p = 16$) with $I = 9.7$, but fall continuously with $I = 100$. At $I = 10$ a glow discharge precedes formation of the arc on striking. At $I = 100$ and $p = 30$ electrons are emitted from the cathode by a thermionic mechanism.

A. J. E. W.

Striking mechanism of long discharge tubes. II. Effect of pre-ionisation on striking. W. Bartholomeyczzyk and E. Wolter (*Ann. Physik*, 1940, [v], 37, 124—136; cf. *ibid.*, 1939, [v], 36, 485).—The striking of a discharge in Ne (pressure p) in a long tube with an auxiliary pre-ionising discharge (current I) at one end has been studied. The dependence of striking voltage on p and I and the current variations and field distribution previous to striking are examined, and discussed with reference to the mechanism of the striking process.

A. J. E. W.

Thermal ionisation of strontium. B. N. Srivastava (*Proc. Roy. Soc.*, 1940, A, 176, 343—351).—Experiments were carried out at different temp. and pressures to determine the equilibrium concn. of Sr^+ and electrons in Sr vapour. The results agree with the theory of thermal ionisation and the known spectroscopic data.

G. D. P.

Charge of the β -particle. R. Ladenburg and Y. Beers (*Physical Rev.*, 1940, [ii], 58, 757).—The charge was determined directly by measuring the charge deposited per sec. on a Faraday collector at the exit slit of a β -ray spectrometer and, after replacing the collector by a Geiger-Müller counter, by counting the no. of particles emerging per sec. To obtain an accurately measurable collector current, a strong source was used for the collector measurements, and the beam was then reduced by a known ratio for the counter measurements by allowing the source to decay. Series of measurements at five vals. of H_p on a Ra-E source gave the mean val. $-4.84_4 \times 10^{-10}$ e.s.u. $\pm 0.6\%$ probable error. Sources of error are discussed.

N. M. B.

Reflexion of positive rays and release of secondary electrons from metallic surfaces. A. Rostagni (*Ric. sci. Progr. tecn. Econ. naz.*, 1938, [ii], 9, I, 633—634; *Chem. Zentr.*, 1938, ii,

22

3517).—A new apparatus for measurements on the neutralisation of positive rays has been tested. Data are given for the release of electrons from Mo, Ni, and clean and contaminated Cu surfaces by Ne^+ and He^+ (velocities 3.3–1140 v.). A. J. E. W.

Change of charge of helium canal rays in gases. H. Meyer (*Ann. Physik*, 1940, [v], 37, 69–75; cf. A., 1938, I, 5).—Equilibrium vals. of the ratio (n_1/n_2) of He^+ to He^{++} ions are determined by magnetic analysis of He canal rays (energy $E = 30$ –200 ke.v.) after passage through a column of gas. With H_2 or air in this column n_1/n_2 falls rapidly from high vals. as E increases, but with He the vals. of n_1/n_2 for low E and the subsequent fall are both much smaller. The pressure-dependence of n_1/n_2 gives a mean free path for the transition from He^+ to He^{++} of 2300 cm., in air at 10^{-3} cm. pressure with $E = 171$ ke.v., whilst that for the reverse process is 80 cm. A. J. E. W.

Uses of charged water vapour. Y. Toriyama, K. Togasawa, Y. Ichimura, and S. Shiratori (*Electrotech. J.*, 1938, 2, 217–218; *Chem. Zentr.*, 1938, ii, 3582).—A method of ionising H_2O or other vapour in a corona discharge is described. Dust particles charged negatively by the ionised vapour are removed from air by an electric field. A. J. E. W.

Lateral diffusion of a stream of ions in a gas. L. G. H. Huxley (*Phil. Mag.*, 1940, [vii], 30, 396–413).—Mathematical. The spatial distribution of ions or of electrons moving in a steady stream through a gas in a uniform electric field is determined theoretically by an analysis which affords solutions in a form convenient for purposes of practical computation and leads to some theoretical generalisations. Important practical cases are discussed and the effects of magnetic fields are considered. O. D. S.

Measurement of nuclear magnetic moments with radio waves. C. J. Gorter (*Nederl. Tijds. Natuurk.*, 1938, 5, 97–101; *Chem. Zentr.*, 1938, ii, 3364–3365; cf. A., 1937, I, 18, and Rabi *et al.*, A., 1938, I, 173, 293).—Higher energy densities are conveniently reached with radio frequencies than with radiation in any other part of the spectrum. A. J. E. W.

Range-groups of natural H rays. J. Riedl (*Anz. Akad. Wiss. Wien, math.-nat. Kl.*, 1938, 55; *Chem. Zentr.*, 1938, ii, 3366).—The energy spectrum of protons ejected from paraffin by α -rays from Po has been examined photographically. Groups with ranges in air of 7.7, 10.1, 11.9, and 13.2 cm. are found; the second and fourth correspond with Frank's first two groups. A. J. E. W.

Scattering of 2.5-Me.v. neutrons in helium. J. A. Wheeler and H. H. Barschall (*Physical Rev.*, 1940, [ii], 58, 682–687).—From the observations of Barschall and Kanner (cf. A., 1941, I, 2), the existence at 2.5 Me.v. of a coupling between the spin and orbital motion of the neutron is deduced. There is some evidence of appreciable interaction between a neutron and an α -particle of 2 units of mutual angular momentum, the classical distance of closest approach of which would be 7×10^{-13} cm. N. M. B.

Internal pair production in radium- C' . R. Thomas (*Physical Rev.*, 1940, [ii], 58, 714–715).—Mathematical. $\text{Ra}-C'$ shows a sharp line of 1.4-Me.v. conversion electrons with no corresponding quanta. Hence the nuclear transition is probably between states of zero angular momentum and like parity. The calc. ratio of pair production to internal conversion of both K electrons for this process is $\sim 0.6\%$. N. M. B.

Existence of thorium-polonium. J. Schintlmeister (*Anz. Akad. Wiss. Wien, math.-nat. Kl.*, 1938, 55; *Chem. Zentr.*, 1938, ii, 3366).—Attempts to detect a new α -radiation due to decomp. of Th-D have been unsuccessful. If an α -active Th-F (“Th-Po”) exists, the half-life of Th-D, -E, or -F is $> 1.0 \times 10^{13}$ years. ^{208}Pb (Th-D) is not the only parent of ^{204}Pb . A. J. E. W.

Reactions produced by neutrons in heavy elements. E. Fermi (*Science*, 1940, 92, 269–271).—An address. L. S. T.

Magnetic lens for β -rays of high energy. V. E. Cosslett (*J. Sci. Instr.*, 1940, 17, 259–264).—A magnetic electron lens of considerably greater focussing efficiency than that of the Fe-shrouded type is described. The fields produced are capable of focussing electrons of 15 Me.v. energy at a focal length of 37.5 cm., without cooling of the coils, and with cooling it could be used for electrons of 20 Me.v. energy. The

optimum conditions for using the lens as a β -ray spectrometer are discussed. The lens has been used in an attempt to detect high-energy electrons from a possible disintegration of Li by slow neutrons, $^7\text{Li} + n_0 \rightarrow ^8\text{Li} \rightarrow ^4\text{He} + ^4\text{He} + e^- + 15.9$ Me.v., but with negative results. This provides independent confirmation of the observation that Li does not behave similarly when bombarded with deuterons and with slow neutrons. A. J. M.

Resonance scattered protons from ^{11}B and ^{19}F . W. R. Kanne, R. F. Taschek, and G. L. Ragan (*Physical Rev.*, 1940, [ii], 58, 693–695).—With $\text{B}(\text{OMe})_3$ and BF_3 as the scattering gases, preliminary work in search of resonance scattering, manifested by a deviation from Rutherford angular distribution for protons of the resonance energy, gave negative results, but upper limits for it were established and a sensitive method for observing small deviations from Rutherford scattering is described. The proton energy producing the resonance in B is 163 ± 6 ke.v. N. M. B.

Scattering of α -particles by carbon and oxygen. A. J. Ferguson and L. R. Walker (*Physical Rev.*, 1940, [ii], 58, 666–671).—Observations of scattering at large angles, with solid targets, and with $\text{Ra}-C'$ as a source, give results showing resonances in C at energies 5.5, 5.0, and 4.4 Me.v. and indicate that the angular momentum quantum no. of the compound nucleus ^{16}O is probably 2 for the highest level and > 0 for the others. Resonances at 6.5 and 5.5 Me.v. were observed in O, indicating excited states of ^{20}Ne with angular momentum probably 1. N. M. B.

Nuclear energy levels in magnesium. T. R. Wilkins and G. Wrenshall (*Physical Rev.*, 1940, [ii], 58, 758).—The angular distribution curve for 6.9-Me.v. protons scattered by Mg shows elastic and inelastic peaks, the inelastic fraction varying markedly with the scattering angle. The peak separations corresponded with ~ 1.3 Me.v. energy difference. Results are compared with those of Al. N. M. B.

Radioactive isotopes of vanadium. L. A. Turner (*Physical Rev.*, 1940, [ii], 58, 679–681; cf. Walke, A., 1940, I, 141).—A review of experimental evidence indicates that V (600 days) should be attributed to ^{49}V rather than to ^{47}V . The relatively low yield of ^{50}V in the (d, n) reaction and of ^{52}V in the (α, p) reaction suggests the existence of undiscovered long-lived isomerides of $^{50}, ^{52}\text{V}$. N. M. B.

Decay of ^{80}Br (4.5 hr.). D. De Vault and W. F. Libby (*Physical Rev.*, 1940, [ii], 58, 688–692; cf. A., 1939, I, 173).—Evidence of a limit of $85 \pm 4\%$ to the chemical extractibility of Br (18 min.) from Br (4.5 hr.) is presented, and this is interpreted as the fraction of Br (4.5 hr.) which emits conversion electrons. γ -Rays of ~ 30 –40 ke.v. average energy were found coming from Br (4.5 hr.) (cf. Grinberg, A., 1940, I, 384). The presence of a γ -ray accompanying Br (18 min.) is confirmed, but its energy is placed above 0.6 Me.v. N. M. B.

Artificially radioactive element 85. D. R. Corson, K. R. MacKenzie, and E. Segrè (*Physical Rev.*, 1940, [ii], 58, 672–678; cf. A., 1940, I, 186).—Bi bombarded with 32-Me.v. α -particles becomes radioactive and emits α -particles of 6.55 and 4.52 cm. ranges (not genetically related), a γ -ray of ~ 0.5 Me.v. energy, an X-ray or soft γ -ray of ~ 80 ke.v. energy, a soft X-ray, and low-energy electrons. All these radiations have the same half-life of 7.5 hr. Evidence indicates that the disintegrating substance is element 85 going to Po by K-electron capture. The probable mechanism is: ^{209}Bi ($\alpha, 2n$) ^{211}Bi ; the ^{211}Bi decays either by K-electron capture to $\text{Ac}-C'$ (^{211}Po) or by α -particle emission (range 4.5 cm.) to ^{207}Bi . The 6.5-cm. α -particles are those of $\text{Ac}-C'$. According to this scheme the second branch from ^{211}Bi leads to ^{207}Bi which should decay to ^{207}Pb (not yet found). The chemical properties of element 85 are discussed. N. M. B.

Passage of uranium fission fragments through matter. W. E. Lamb, jun. (*Physical Rev.*, 1940, [ii], 58, 696–702).—The ranges and rates of energy loss of the fission fragments of U are calc. on the basis of a model in which the charge of the fragment is obtained from its energy and its successive ionisation potentials. The energy-loss cross-section for protons of the same velocity is then used to calculate the ranges of the two groups of fragments. For $Z_1 = 42$, $A_1 = 100$ these are 2.42, and for $Z_2 = 50$, $A_2 = 136$ 2.08 cm., for a total assumed kinetic energy of 188 Me.v. and a final kinetic energy of the lighter fragment of 5 Me.v. These are in fair agreement with

the observed ranges of 2.2 and 1.5 cm. The experimental and theoretical range-energy relations are also in fair agreement. The validity of the model is discussed, and appears fairly good for fragments >5 Me.v. The initial charges of the fission fragments are 17 and 13. The density of ionisation decreases along the track, in marked contrast to the behaviour for protons and α -particles. N. M. B.

Radioactive barium and strontium from photo-fission of uranium. A. Langer and W. E. Stephens (*Physical Rev.*, 1940, [ii], 58, 759; cf. Haxby, A., 1940, I, 341).—In order to determine whether photo-fission produces the same radioactive elements and with similar relative yields as neutron fission, U was irradiated with slow neutrons, with fast neutrons, and with γ -rays, Ba and Sr were separated chemically, and decay curves examined. These show the production of Ba (86 min.) and Sr (6 hr.) by neutron- and by photo-fission. The ratio of the initial activity of the two products is approx. the same for both slow and fast neutron fission as for γ -fission. N. M. B.

Latitude effect of extensive cosmic-ray showers. H. V. Neher and W. H. Pickering (*Physical Rev.*, 1940, [ii], 58, 665–666).—Owing to statistical fluctuations of the results, measurements of large cosmic-ray shower intensities on the Pacific Ocean lead to no positive conclusions on the latitude effect. N. M. B.

Essential assumptions of a theory of atomic structure. L. A. Goldblatt and A. H. Croup (*J. Chem. Educ.*, 1940, 17, 378–379).—A summary of modern views of at. structure.

L. S. T.

Inelastic scattering of a beam of particles by hydrogen and helium. K. C. Kar (*Phil. Mag.*, 1940, [vii], 30, 487–504; cf. A., 1938, I, 4).—Mathematical. The previously developed theory is extended to inelastic scattering leading to excitation. Its application to the experiments of Dymond and Watson (*Proc. Roy. Soc.*, 1929, 122, 571), Van Atta (A., 1931, 1206), and Mohr and Nicoll (A., 1932, 1185) is discussed.

O. D. S.

Connexion between spin and statistics. W. Pauli (*Physical Rev.*, 1940, [ii], 58, 716–722).—Mathematical. For the relativistically invariant wave equation for free particles, the postulate of positive energy leads to Fermi-Dirac statistics for particles with arbitrary half-integral spin, and the postulate of commutability of observables on different space-time points with a space-like distance leads to Einstein-Bose statistics for particles with arbitrary integral spin.

N. M. B.

Relativistic self-consistent field for Cu^+ . A. O. Williams, jun. (*Physical Rev.*, 1940, [ii], 58, 723–726).—Mathematical. From the improved Hartree self-consistent field solution, by substitution of the Dirac relativistic one-electron equation for the Schrödinger one-electron equation, the numerical solution, without exchange, for the inner shells of Cu^+ is outlined, and tables of the resulting energy parameters and charge density distribution are given and discussed.

N. M. B.

Operator calculus in the electron theory of metals. K. Fuchs (*Proc. Roy. Soc.*, 1940, A, 176, 214–228).—A calculus is developed applicable to the electron theory of metals. It differs from the common operator calculus of the quantum theory in that the wave function is defined in the at. polyhedron, and this leads to the introduction of surface operators.

G. D. P.

Inner excited states of the proton and neutron. W. Heitler and S. T. Ma (*Proc. Roy. Soc.*, 1940, A, 176, 368–397).—To avoid the difficulties of applying the meson theory to the interaction of fast mesons with nuclear particles it is proposed that the charge and spin of an electron can assume higher quantum states. The theory is developed and the possibility of observing the new particles is discussed.

G. D. P.

II.—MOLECULAR STRUCTURE.

Relation between potential energy and interatomic distance in diatomic molecules. J. W. Linnett (*Trans. Faraday Soc.*, 1940, 36, 1123–1134).—The reciprocal-exponential expression $V = a/r^m - be^{-nr}$ is shown to be more satisfactory than either a double-reciprocal or a double-exponential function for representing the variation of potential energy with the distance between two bonded atoms. The expression is ex-
B 2 (A., I.)

amined in detail and tested against experimental data for a no. of diat. mols. F. L. U.

Spectroscopic evidence of the B_2 molecule and determination of its structure. A. E. Douglas and G. Herzberg (*Canad. J. Res.*, 1940, 18, A, 165–174).—A new ultra-violet band system observed in a discharge in He containing a trace of BCl_2 has been attributed to B_2 and the vibrational and rotational structures have been analysed. The electronic transition is probably $^2\Sigma_u^- \rightarrow ^3\Sigma_g^-$. The lower (ground) state has a vibrational frequency $\omega_0 = 1041.9 \text{ cm}^{-1}$, internuclear distance $r_0 = 1.594 \text{ \AA}$, and force const. $k_0 = 3.52 \times 10^{-8} \text{ dynes per cm}$. The nuclear spin of ^{11}B derived from the intensity alternation is 5/2, which does not agree with recent theoretical predictions, based on the Hartree model and on the α -particle model of the nucleus. F. J. G.

Emission spectrum of antimony nitride. (Miss) N. H. Coy and H. Spomer (*Physical Rev.*, 1940, [ii], 58, 709–713; cf. A., 1938, I, 293).—In a discharge through a mixture of N_2 and Sb vapour a new band system of SbN is found, and from the vibrational analysis a formula for the heads is obtained. A comparison of mol. consts. for N_2 , PN , AsN , and SbN suggests that the electronic transition for the new system is $^1\Pi \rightarrow ^1\Sigma$. N. M. B.

Ultra-violet absorption of nitrous oxide. J. Nicolle (*Publ. Fac. Sci. Univ. Paris*, 1940, 34 pp.).—Absorption measurements for $\lambda\lambda$ 2150–2350 \AA . at 20° and -90° and 100–760 mm. pressure are reported, and mol. extinction coeffs. are calc. Results are discussed with reference to available data and give an approx. absorption limit at 2350 \AA , from which, with the help of the heat of dissociation of N_2 and data on the spectra in the Schumann region, the probable mechanism of photochemical reactions of N_2O are deduced. No pressure effect is found, but there is a temp. effect between 20° and -90° which can be explained on the assumption of a steep slope in the potential energy curve of the system $\text{NO} + \text{N}$. N. M. B.

Infra-red absorption studies. XI. NH-N and NH-O bonds. A. M. Buswell, J. R. Downing, and W. H. Rodebush (*J. Amer. Chem. Soc.*, 1940, 62, 2759–2765).—The absorption spectrum of NH_2Ph is discussed. The shift of 85 cm^{-1} to shorter λ may be insufficient to merit the attribution of H-bonding. When small energies of H-bond formation are involved it is possible that factors other than H-bonding come into play. All proteins exhibit absorption in the 3μ region. Spectra of acetylglycine Et ester (solid and in CCl_4) and Et 3:5-dimethylpyrrole-2-carboxylate (in CCl_4) show peaks possibly attributable to NH-N and NH-O bonds. To prove the existence of characteristic ν for these bonds NHPh_2 (solid and in CCl_4) and mixtures of NHPh_2 with NMe_2Ac have been investigated. Evidence for NH-N bonds but not for NH-O bonds is thereby obtained. From examination of solid films of NH_2Ac , $\text{CCl}_3\text{CO}\cdot\text{NH}_2$, $\text{Bu}^n\text{CO}\cdot\text{NH}_2$, diketopiperazine, glycine, alanine, and $\text{NH}_2\cdot\text{SO}_3\text{H}$ it is shown that proteins have similar spectra to N-substituted amides and contain isolated NH-O' bonds (3.0μ) and NH-O' bonds in pairs (3.22μ). The peptide linking is considered to be NH-O. The NH-O' bond has the same frequency as the NH-N. The amide group has the co-planar structure $-\text{C}(\text{O}^-):\text{N}$ which persists in proteins, therefore giving *cis*- and *trans*-H atoms. W. R. A.

Hydrogen bridging in cellulose as shown by infra-red absorption spectra. J. W. Ellis and (Miss) J. Bath (*J. Amer. Chem. Soc.*, 1940, 62, 2859–2861).—In the region 1–2.5 μ . cellulose (ramie) fibres in a mixture of CS_2 and CCl_4 ($n \approx 1.57$) show two bands at 1.51 and 1.58 μ , indicating the presence of OH vibrators perturbed by H-bonding, and a weak band at 1.44 μ , indicating that few unperturbed OH groups exist in the mol. These conclusions are substantiated by the spectrum in the 2 μ region. W. R. A.

Electron transition-vibration combinations in the spectra of praseodymium salts. (Fr.) A. Hellwege (*Ann. Physik*, 1940, [v], 37, 226–248; cf. A., 1939, I, 508).—The complete absorption spectrum of $\text{Pr}_2\text{Zn}_3(\text{NO}_3)_{12}\cdot 24\text{H}_2\text{O}$ (I) (including polarisation data) at 16,800–23,000 cm^{-1} , and relevant portions of the spectra of $\text{Pr}(\text{NO}_3)_3\cdot 6\text{H}_2\text{O}$ and $\text{Pr}_2(\text{SO}_4)_3\cdot 8\text{H}_2\text{O}$, are recorded; photometer curves are given for some systems. Certain data are also given for $\text{Pr}(\text{EtSO}_4)_3\cdot 9\text{H}_2\text{O}$, $\text{Pr}_2\text{Mg}_3(\text{NO}_3)_{12}\cdot 24\text{H}_2\text{O}$, and $\text{Pr}_2\text{Zn}_3(\text{NO}_3)_{12}\cdot 24\text{D}_2\text{O}$. The splitting of various terms in the

cryst. field is not in accord with Bethe's theory. As in the case of Nd salts (Ewald, A., 1939, I, 118) the lines may be assigned to electronic transitions with superimposed external or internal lattice vibrations. In the (I) spectrum certain electron transitions forbidden by symmetry appear in combination with lattice vibrations, the intensity increasing with the ν of the latter. Combinations of external lattice vibrations give some lines which are stronger than lines for pure transitions, but internal lattice vibrations give much weaker lines.

A. J. E. W.

Ultra-violet absorption and fluorescence of luminol at different p_H values. E. Briner and E. Perrottet (*Helv. Chim. Acta*, 1940, 23, 1253—1257).—In solutions of $p_H < 6$ the ultra-violet absorption spectrum of luminol shows max. at 2900 and 3500 Å., but in solutions of $p_H > 7$ there is only a flat max. at 3200 Å. The fluorescent form is the one yielding the two max. The narrow p_H range (7—8) over which luminol shows fluorescence suggests the possibility of its use as fluorescent p_H indicator.

J. W. S.

Chemical war materials. XVIII. Ultra-violet absorption and dipole moments of some compounds of similar structure to $\beta\beta'$ -dichlorodiethyl sulphide. H. Mohler and J. Sorge. **XIX. Chemical and spectroscopic properties of $\beta\beta'\beta''$ -trichlorotriethylamine (skin poison) and its hydrochloride.** H. Mohler and W. Hämmerle (*Helv. Chim. Acta*, 1940, 23, 1200—1211, 1211—1216).—XVIII. The absorption spectra of H_2O or C_6H_{14} solutions of various derivatives of Et_2O and Et_2S have been measured in the region 2000—3500 Å., and are compared with the spectra of furan and thiophene. The results accord with the view that interaction occurs between the H and Cl atoms in compounds of the type of $S(CH_2CH_2Cl)_2$ (I) (cf. A., 1938, I, 557). From measurements on solutions in C_6H_6 and C_6H_{14} the following dipole moments (in D.) are deduced; $O(CH_2CH_2OH)_2$ 2.31, $OEt[CH_2]_2OH$ 2.10, $OEtCHMeOH$ 1.62, $OEt[CH_2]_2Cl$ 2.18, $CHClMeO[CH_2]_2Cl$ 1.76, $CHClMeOEt$ 1.81, and $O(CH_2CH_2Cl)_2$ 2.40.

XIX. The properties of $N(CH_2CH_2Cl)_3$ (A., 1935, 849) (II) and its hydrochloride (III) are described. The absorption spectra of solutions of (II) in C_6H_{14} and in $EtOH$ are identical, but that of (III) in $EtOH$ is displaced slightly to shorter λ . The form of the absorption curve is similar to that for heterocyclic ring compounds. The vesicant action of the compound suggests that this property of (I) is attributable to the $-CH_2CH_2Cl$ groups.

J. W. S.

Effect of molecular environment on absorption spectra of organic compounds in solution. I. Conjugated dienes. H. Booker, L. K. Evans, and A. E. Gillam (*J.C.S.*, 1940, 1453—1463).—Experimental data on the absorption spectra of compounds containing the chromophore present in conjugated dienes, e.g., $CH_2=CH\cdot CH=CH_2$, are collected in order to discover the effect of well-defined mol. environments on the spectra. The absorption max. due to this chromophore lies within the limits 2170—2820 Å. (for compounds in $EtOH$ solution), and the intensity may rise to $\epsilon = 35,000$, but is usually 8000—20,000. The following classes of compounds are recognised: acyclic dienes with no, one, or two cyclic substituents, semicyclic dienes, and mono-, di-, and polycyclic dienes. The introduction of a single saturated cyclic substituent into the simple butadienes lowers the val. of ϵ considerably, but the introduction of two such groups causes ϵ to increase again. Semicyclic dienes have absorption max. very close to those of acyclic dienes with a single cyclic substituent. λ_{\max} are considerably longer for monocyclic dienes than for acyclic dienes, and ϵ is much smaller. In polycyclic dienes, the arrangement of the conjugated system in one or in two rings, respectively, has a marked effect on the position of the absorption max.

A. J. M.

Ultra-violet absorption spectra of lignin and related compounds. R. E. Glading (*Paper Trade J.*, 1940, 111, *TAPPI Sect.*, 288—295).—The absorption spectra of spruce native lignin and its derivatives show that at ~ 280 m μ . the absorption coeff. \propto the amount of native lignin in the material, but this does not hold for (a) lignins in which the non-lignin material has a high absorption coeff. near 280 m μ ., (b) methanol-lignins, or (c) lignins isolated from woods by an alkaline agent. Observed and calc. absorption coeffs. of $PhOH$ - and $PhSH$ -native lignins are in fair agreement. By comparing the spectra of β -hydroxychalcone, flavanone, quercetin, native lignin, and demethylated acetylated Willstätter

lignin it was concluded that the spectrum of native lignin could be explained by assuming that each building unit of it contained two pyran rings which give rise to the absorption at 281 m μ . The non-appearance of the 352 m μ . band in the spectra of native lignin and other lignins is attributed to the almost complete enolisation of the $C=O$ group which gives rise to this band.

W. R. A.

Effect of crystal orientation on the Raman spectrum of calcite. S. Bhagavantam and B. P. Rao (*Current Sci.*, 1940, 9, 409—410).—Previously reported anomalies in the intensities of the components of the 1084 cm^{-1} line of $CaCO_3$ at particular crystal orientations (A., 1940, I, 195) have been traced to inadequate control of polarisation and collimation.

W. R. A.

Raman spectra and molecular structure of aliphatic cyclic compounds. B. D. Saksena (*Proc. Indian Acad. Sci.*, 1940, 12, A, 321—336).—The Raman displacements and their depolarisation factors have been measured for cyclo-hexane (I), -hexanol (II), -hexanone (III), dioxan (IV), and paraldehyde (V). Assuming that (I) is a puckered hexagon, symmetry S_{6h} , the character table, symmetry co-ordinates, no. of ring vibrations, selection rules, and no. of vibrations for the mol. are derived. Experimental data are in accord and indicate that (I) has a *trans* symmetry for the ring. (II), (III), and (V), have puckered structures. (IV) is predominantly in the *trans*-form but some *cis*-form is also present.

W. R. A.

Raman spectra and hydroxyl frequencies of fatty acids. B. D. Saksena (*Proc. Indian Acad. Sci.*, 1940, 12, A, 312—320).—Raman spectra for CCl_3CO_2H (I) (solid, molten, 25 and 75% aq. solutions), $CHCl_2CO_2H$ (II), $AcOH$, and HCO_2H are recorded and discussed. The behaviour of various ν of (I) on fusion or dissolution enables the assignments of ν to polymerides, monomeride, and the CCl_3CO_2' ion. From the position of the OH frequency it is concluded that (I) is strongly associated. All four acids show O—H bands, the displacements (in cm^{-1}) from the normal val. of the OH frequency being: HCO_2H 398, $AcOH$ 408, (II) 324, (I) 612. Force consts. for various linkings in HCO_2H and $AcOH$ are suggested.

W. R. A.

Quenching of resonance radiation of sodium. R. G. W. Norrish and W. MacF. Smith (*Proc. Roy. Soc.*, 1940, A, 176, 295—312).—The effective cross-section for quenching Na resonance radiation by saturated and unsaturated hydrocarbons, *tert.* amines, and several diat. mols. was measured. As regards quenching ability the gases fall into two groups, the saturated hydrocarbons and inert. gases being weakly quenching, the unsaturated hydrocarbons and amines strongly quenching. Within any one series the no. of atoms in a mol. appears to have little influence on the quenching ability which, it is concluded, arises from a centre of unsaturation.

G. D. P.

Relations between colour and constitution of organic silver salts and their spectral sensitivity distribution. G. Ungar (*Radiologica*, 1938, 2, 49—56; *Chem. Zentr.*, 1938, ii, 3527).—The spectral sensitivity curves of a no. of white and coloured org. Ag salts have been determined. The white salts (particularly Ag salicylate emulsions and salts of simple salicylic acid derivatives) give broad max. at 640—570 m μ . With coloured salts the colour, rather than the constitution, determines the sensitivity. The max. for yellow salts and Ag eosin are at 500—600 m μ .; other red salts are sensitive only at < 550 m μ ., and the sensitivity, like that of green and grey salts, increases with decreasing λ .

A. J. E. W.

Electro-optical properties of broken-down zinc sulphide-copper phosphors. F. Goos (*Ann. Physik*, 1940, [v], 37, 76—88; cf. A., 1939, I, 58).—When $ZnS-Cu$ phosphors are broken down by α -rays, absorption, primary photoelectric current, and extinction effects develop at long λ . The "red effect" on the primary current also occurs in ZnS crystals, and increases with the degree of breakdown; it is due to separation of Zn in the lattice. A method of studying this effect without interference of polarisation and after-effects is described. The extinction effect, which is followed by the change of dielectric const., is also attributed to separation of Zn, but it is a sp. phosphorescence effect involving the emissive centres and is thus distinct from the red effect.

A. J. E. W.

Yellow and red zinc silicate phosphors. G. R. Fonda (*J. Physical Chem.*, 1940, 44, 851—861).—The prep., at 850° and

by fusion, of Zn_2SiO_4 fluorescing yellow and red is described. The presence of amorphous Zn_2SiO_4 is essential for yellow fluorescence whilst red fluorescence occurs with an amorphous complex of SiO_2 and ZnO with the amount of $\text{SiO}_2 >$ that corresponding with Zn_2SiO_4 . To obtain the yellow phosphor a rate of cooling, essentially rapid, must be chosen which allows crystallisation of SiO_2 , but not of Zn_2SiO_4 . If neither crystallises the red phosphor is formed; if both crystallise the green is formed. The green variety is formed if the reaction is allowed to proceed too far as a result of too high a temp., the presence of a catalyst, or the use of too fine oxides.

C. R. H.

Dielectric constants of some metallic sulphates containing various amounts of water of crystallisation. C. K. Cheng (*Phil. Mag.*, 1940, [vii], 30, 505—515).—A method of measurement of the dielectric const. ϵ of powdered salts by suspending them in mixed liquids of similar ϵ and determining ϵ of the mixture for which no change in ϵ occurs on addition of the solid is described. ϵ of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, $\text{CuSO}_4 \cdot \text{H}_2\text{O}$, $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, $\text{MgSO}_4 \cdot \text{H}_2\text{O}$, $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$, $\text{ZnSO}_4 \cdot \text{H}_2\text{O}$, and $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ have been measured. The mol. polarisation P of the H_2O mol. in the first three pairs of compounds is calc. on the assumption that P of the crystal is the sum of the P vals. of its component mols. and is found in all cases to be approx. equal to but slightly $>$ P of the H_2O mol. in ice.

O. D. S.

Electric moments of substituted benzoic acids. C. S. Brooks and M. E. Hobbs (*J. Amer. Chem. Soc.*, 1940, 62, 2851—2854).—The following vals. for electric moments in dioxan at 30° are given: PhCl , 1.61; PhBr , 1.58; BzOH , 1.78; m - and p - $\text{C}_6\text{H}_4\text{BrCO}_2\text{H}$, 2.15 and 2.08 d. The angle made by CO_2H with the C—C line is $\sim 76^\circ$ compared with 85° calc. from additivity of bond moments; the discrepancy is explained on the basis of resonance. Resonance is used also to explain why p - $\text{C}_6\text{H}_4\text{ClCO}_2\text{H}$ has a moment $<$ that of p - $\text{C}_6\text{H}_4\text{BrCO}_2\text{H}$. The free rotation of the CO_2H group has been studied but no definite conclusions could be drawn.

W. R. A.

Additivity of molecular volumes. II. Molecular volumes of paraffin hydrocarbons. N. F. Komschilov (*J. Gen. Chem. Russ.*, 1940, 10, 945—949).—The mol. vols. of isomeric paraffin hydrocarbons differ, being least when the constituent atoms are grouped around a central atom, and greatest with terminally branched chains. Increments for radicals substituted into different atoms of chains are derived empirically.

R. T.

Molecular volume of butadiene at different pressures. B. A. Dolgoplosk and Korneev (*Sintet. Kautschuk*, 1936, No. 4, 15—18).—Within the limits 20.9 mm. to 1376 mm. at 15° and 56.1 mm. to 778.3 mm. at 0° deviations from the ideal gas are proportional to the partial pressure of butadiene. The mol. vol., $v = 22.41[1 - \lambda(P - 100)]$, where P is the partial pressure of butadiene and $\lambda = 0.000044$ at 15° and 0.00005 at 0° .

Ch. Abs. (e)

Theory of structure of hydrides of boron. B. V. Nekrassov (*J. Gen. Chem. Russ.*, 1940, 10, 1021—1030).—The analogy between B hydrides and hydrocarbons is only an apparent one. The former are considered to be co-ordination complexes of BH_3 .

R. T.

Stereochemical types and valency groups. N. V. Sidgwick and H. M. Powell (*Proc. Roy. Soc.*, 1940, A, 176, 153—180).—Bakerian lecture. The spatial arrangements of the covalencies of a multivalent atom, while subject to small variations (usually $< 5^\circ$ or 10°), tend to conform to a limited no. of types. This grouping is related to the size of the valency group of the central atom, the no. of shared electrons it contains, and that of the preceding (unshared) electronic group in the atom. The relations shown by the experimental results are described.

G. D. P.

Approach to magnetic saturation. W. F. Brown, jun. (*Physical Rev.*, 1940, [ii], 53, 736—743).—Mathematical. If the internal forces responsible for the incompleteness of saturation vary rapidly over shorter distances, instead of being approx. uniform over distances containing a large no. of atoms as in the standard treatment, the interat. coupling forces prevent the direction of microscopic magnetisation from varying with equal rapidity, and the $1/H^2$ law no longer follows. The forms taken by the law under various conditions are deduced and interpreted.

N. M. B.

Formulation of ions electronically. G. N. Copley (*Chem. and Ind.*, 1940, 815—816).—It is unnecessary to indicate that

an electronic formula represents an ion by enclosing it in brackets and suffixing a $+$ or $-$ sign, or otherwise indicating polarity. In some cases, e.g., SO_4^{2-} , it is impossible to allocate positions to the $+$ or $-$ signs. It is illogical to use the same symbol to represent the neutral atom and the core, but no confusion arises by doing so.

A. J. M.

Molecular fields of force: retrospect and suggestions. S. Chapman (*Nature*, 1940, 146, 607—609).

L. S. T.

Image and van der Waals forces at a metallic surface. J. Bardeen (*Physical Rev.*, 1940, [iii], 58, 727—736).—Mathematical. Calculations based on a model which takes the structure of the metal into account indicate that the force on an electron outside the surface is the classical image force, but that the van der Waals force on a neutral mol. may be smaller than that given by a semi-classical calculation based on the method of images. An approx. val. of the van der Waals energy between two systems is obtained, and the method leads to a new approx. formula for the van der Waals interaction between two mols. The relation to the energy found by the image method is examined.

N. M. B.

Properties of liquids in fine capillaries. I. Surface tension and density. L. H. Cohan and G. E. Meyer (*J. Amer. Chem. Soc.*, 1940, 62, 2715—2716).— γ and ρ for H_2O and PhMe have been measured at 23° in capillaries of diameter as small as 4μ . and vals. are in agreement with normal vals. It is concluded that the explanation given by Shereshefsky (A., 1929, 128) that lowering of v.p. in fine capillaries is due to increase in γ is inadmissible.

W. R. A.

Physical properties and chemical constitution. VI. Saturated and unsaturated cyano-esters. D. M. Cowan and A. I. Vogel (*J.C.S.*, 1940, 1528—1531).— n_D^{20} for C, D, F, and G' lines and ρ and γ over a range of temp. have been determined for $\text{CN}\cdot\text{CH}_2\cdot\text{CO}_2\text{Et}$, $\text{CRR}'\cdot\text{C}(\text{CN})\cdot\text{CO}_2\text{Et}$ ($\text{RR}' = \text{MeEt}$, EtEt , MePr^a , EtPr^a , Pr^aPr^a) and $\text{CHRR}'\cdot\text{CH}(\text{CN})\cdot\text{CO}_2\text{Et}$ ($\text{RR}' = \text{MeMe}$, MeEt , EtEt , MePr^a , EtPr^a , Pr^aPr^a). The mol. refractivities and parachors have been computed and compared with calc. vals. The observed parachors are $<$ calc. vals. Mol. refractivities show an exaltation of the unsaturated esters, due, probably, to the conjugated system $>\text{C}=\text{C}:\text{C}=\text{N}$. Vals. of $>\text{CH}_2$ groups are listed; the parachor val. is $<$ the accepted val. of 39—40 units.

W. R. A.

III.—CRYSTAL STRUCTURE.

Extra spots of the Laue photograph. (Sir) W. Bragg (*Nature*, 1940, 146, 509—511).—Conditions under which a pattern of diffuse spots will be produced are discussed. Predicted positions of diffuse spots for the X-ray photograph of KCl are compared with those shown on the photograph itself, and show good agreement.

L. S. T.

Modified reflexion of X-rays. (Sir) C. V. Raman and P. Nilakantam (*Nature*, 1940, 146, 523).—The geometric law of quantum or modified reflexion is given by $2d \sin \frac{1}{2}(\theta + \phi) = n\lambda$, where d is a crystal spacing, and θ and ϕ are the glancing angles of incidence and reflexion with respect to such spacing. The formula shows that the angle between the incident and reflected rays is independent of the setting of the crystal. The actual crystal spacing and the vals. of d calc. from $n\lambda = (\sin \theta + \cos \theta \tan \phi)$ (cf. A., 1940, I, 285) do not agree. The well-defined character of the quantum reflexions given by an ideal crystal is illustrated by a photograph of a strongly-exposed Laue pattern of calcite.

L. S. T.

Comparison of the use of crystal-reflected and filtered X-rays in liquid diffraction patterns. R. Q. Gregg and N. S. Gingrich (*J. Sci. Instr.*, 1940, 11, 305—307).—X-Ray diffraction patterns of liquid Na have been obtained with the $\text{Mo K}\alpha$ doublet under conditions of monochromatisation by calcite or rock-salt reflexion, or by filtration through ZrO_2 filters. Sharp patterns were obtained with calcite or rock-salt reflexion. With filtered radiation spurious peaks were observed in the pattern. The sharpness and accuracy of the pattern with filtered radiation can be improved by decreasing the tube voltage and the width of the collimating slits, but the intensity is then $<$ that obtained by rock-salt reflexion. The latter is the most convenient method of monochromatisation.

O. D. S.

Technique for X-ray powder photography of reactive metals and alloys, with special reference to the lattice spacings of

magnesium at high temperatures. G. V. Raynor and W. Hume-Rothery (*J. Inst. Metals*, 1939, **65**, *Advance copy*, 477—485).—Filings of Mg prepared by hand-filing in air contain only 98.95—99.27% Mg, and under paraffin 99.3—99.6% Mg. A glass apparatus has been designed by means of which it is possible to prepare fine drillings containing 99.98% Mg by using a dental drill in an atm. of A and transferring the filings through a sieve into a SiO₂ capillary in the same atm. X-Ray examination of these filings at 10° and at 310° gave lattice consts. of: at 10°, *a* 3.2017, *c* 5.1986, *c/a* 1.6237; at 310°, *a* 3.2278, *c* 5.2423, *c/a* 1.6241. By filling the tube with paraffin the following vals were obtained at 597°: *a* 3.2699, *c* 5.2772, *c/a* 1.6245. Up to 310° (= 0.63 × m.p. in ° K.) expansion is linear, the coeff. being 27.2 × 10⁻⁶ perpendicular to the hexagonal axis and 28.1 × 10⁻⁶ parallel thereto. Between 455° and 600° the mean vals. of these coeffs. become 39.3 and 40.2 × 10⁻⁶, respectively. A. R. P.

X-Ray structure and elastic strains in copper. S. L. Smith and W. A. Wood (*Proc. Roy. Soc.*, 1940, **A**, **176**, 398—411).—An X-ray examination of Cu was made while the metal was under stress. It is shown that the permanent strain is associated with breakdown of the grains and that this change is irreversible. The elastic strain is accompanied by reversible changes in dimensions of the at. lattice, which take place without leaving any permanent distortion in the lattice. Quant. measurements were made on strains exhibited by the (400) and (331) planes and these are compared with the equiv. external elastic constants. The measurements show that marked differences of strain may exist in neighbouring grains and provide an explanation of the extensive breakdown of the grains into components of widely different orientation which characterises the structure of a polycryst. metal after deformation beyond the elastic limit. G. D. P.

Crystal structure of CuMg₂. (Miss) G. Ekwall and A. Westgren (*Arkiv Kemi, Min., Geol.*, 1940, **14**, **B**, No. 7, 8 pp.).—CuMg₂ is orthorhombic, with *a* 5.273, *b* 9.05, *c* 18.21 Å., and 16 mols. in unit cell. A. J. M.

Crystal structure of cementite. H. Lipson and N. J. Petch (*Iron and Steel Inst.*, Sept., 1940, *Advance copy*, 9 pp.).—The position of the C atoms in Fe₃C has been established by direct calculation of the electron density in two different planes of the unit cell. The structure is orthorhombic, *a* 4.5144, *b* 5.0787, *c* 6.7297 Å., unit cell containing 12 Fe and 4 C atoms, space-group *Pbnm*. The Fe atoms are almost close-packed with the C atoms in the interstices. A diagram of the probable structure is given and its relation to the ferrite and austenite structures is briefly discussed. A. R. P.

Modified reflexion of X-rays by crystals: calcite. S. Bhagavantam and J. Bhimasenachar (*Proc. Indian Acad. Sci.*, 1940, **12**, **A**, 337—339).—Modified X-ray reflexions from (211) planes of calcite, due to Cu K_α and K_β radiations, lead to an approx. const. spacing in good agreement with the accepted val. of 3.029 Å. W. R. A.

Orthorhombic crystalline modification of diphenylocta-tetraene. K. S. Krishnan, S. L. Chorghade, and T. S. Anantapadmanabhan (*Trans. Faraday Soc.*, 1940, **36**, 1153—1155).—A detailed account of work previously published (*A.*, 1940, **I**, 432). F. L. U.

Crystal chemistry of the phosphates, arsenates, and vanadates of the type A₂XO₄(Z).—See *A.*, 1941, **I**, 64.

Classification of Kossel-Möllenstedt electron interferences in space-lattice theory. M. von Laue (*Ann. Physik*, 1940, [v], **37**, 169—172; cf. *ibid.*, 1939, [v], **36**, 113).—Theoretical. A. J. E. W.

Electron diffraction investigation of molecular structure of dilead hexamethyl. H. A. Skinner and L. E. Sutton (*Trans. Faraday Soc.*, 1940, **36**, 1209—1212).—The main bond distances in Pb₂Me₆ are: Pb—Pb 2.88 ± 0.03 Å., Pb—C 2.25 ± 0.06 Å. F. L. U.

Electron diffraction investigation of molecular structure of aluminium trimethyl in the vapour phase. N. R. Davidson, J. A. C. Hugill, H. A. Skinner, and L. E. Sutton (*Trans. Faraday Soc.*, 1940, **36**, 1212—1225).—Al₂Me₆ has an C₂H₆-like structure, in which the distances are: Al—Al 2.62 ± 0.06 Å., Al—C 2.05 ± 0.05 Å.; C—Al—Al = 105 ± 10°. Various models are described and discussed. It is not possible to determine whether the C atoms are in the "staggered" or

"eclipsed" positions, nor whether the Me groups are free to rotate. F. L. U.

Magnetic measurements on active aluminium oxides and hydroxides. K. E. Zimens (*Svensk Kem. Tidskr.*, 1940, **52**, 205—222).—The question whether there is a direct connexion between magnetic properties and imperfections of lattice structure is discussed in the light of published instances of changes in magnetic properties accompanying the formation of active states of various paramagnetic solids. Vals. of χ for various preps. of γ -Al₂O₃, γ -AlO·OH, γ -Al(OH)₃, and α -Al₂O₃ are recorded. A slight dependence of χ on temp. is to be attributed to its dependence on H₂O content, which is discussed; there is no connexion between χ and the various active states. F. J. G.

Theoretical study of a possible model of paramagnetic alums at low temperatures. J. A. Sauer and H. N. V. Temperly (*Proc. Roy. Soc.*, 1940, **A**, **176**, 203—213).—The model is a lattice of freely suspended magnets, all interactions except purely magnetic being neglected. Theory predicts that the state of lowest energy is either a spontaneously magnetised state for a long thin specimen or a state in which alternate rows of magnets point in opposite directions for a sphere; spontaneous magnetisation appears in an ellipsoid when the eccentricity exceeds a certain crit. val. The effect of shape on magnetic properties is in qual. agreement with experiment. G. D. P.

Distribution of autolectronic emission from single crystal metal points. I. Tungsten, molybdenum, nickel in the clean state. M. Benjamin and R. O. Jenkins (*Proc. Roy. Soc.*, 1940, **A**, **176**, 262—279).—The field emission from points of 0.5 μ . diameter is observed under different conditions of temp. It is found that surface mobility occurs above 1170° K. for W, 770° K. for Mo, and 370° K. for Ni. The changes in the distribution of intensity in the patterns are explained in terms of a change of geometrical shape of the point, caused by the high external field acting on the mobile surface atoms. The flash-over phenomenon is discussed and the effect of traces of gas investigated. Suggestions are put forward to explain the dependence of emission on the crystal structure of the metal. G. D. P.

Location of hysteresis phenomena in Rochelle salt crystals. W. P. Mason (*Physical Rev.*, 1940, [ii], **58**, 744—756; cf. *A.*, 1939, **I**, 307; Mueller, *A.*, 1940, **I**, 287).—A theoretical formulation of the equations of motion of a piezoelectric crystal, taking account of the dissipation effects, is made. The frequency variation of the clamped ϵ , when interpreted by Debye's theory of dielectrics, modified to take account of hysteresis losses, indicates that there are two components, one of which, having associated with it a high viscous resistance, has $\epsilon \approx 140$ at 0° and is probably due to the dipoles of the Rochelle salt; the other, a non-viscous component, has $\epsilon \approx 100$ at 0°, and is probably due to the displacement of the ions in the lattice structure. Both components have higher ϵ and hysteresis between the Curie points, indicating a co-operative action of the mols. for both components in this temp. region. N. M. B.

Electrification of powdered insulators. (Sir) A. Fleming (*Proc. Physical Soc.*, 1941, **53**, 51—53; cf. *A.*, 1939, **I**, 307).—Experiments with S or dry SiO₂ powders poured in a stream on to a metal plate show that the charge developed is not entirely due to the particles impinging on the metal but is partly obtained in the process of pouring. An apparatus is described, consisting of a long tube containing perforated Zn plates and closed at the ends by metal canisters, whereby on repeated reversal, on the hour-glass principle, the falling SiO₂ powder causes the canisters to acquire a cumulative charge, and this can be used to charge a condenser. Electrons tend to pass from the medium of high electron density (Zn plate) to the falling insulator powder. N. M. B.

IV.—PHYSICAL PROPERTIES OF PURE SUBSTANCES.

Reduction of the Wiedemann-Franz law of thermal and electrical conductivity of metals to an absolute form. L. Labocchetta (*Ric. Sci. Progr. tecn. Econ. naz.*, 1938, [ii], **9**, 262—263; *Chem. Zentr.*, 1938, ii, 3521). A. J. E. W.

Adiabatic temperature changes accompanying the magnetisation of ferromagnetic materials in low and moderate fields. L. F. Bates and J. C. Weston (*Proc. Physical Soc.*,

1941, 53, 5—34).—A new simplified method for measuring heat changes accompanying magnetisation processes in fields of \sim a few hundred oersteds is described. The adiabatic temp. changes of a rod taken step by step through a hysteresis cycle are measured by a series of thermocouples of which the hot junctions are directly attached to the rod. The sensitivity is $\sim 10^{-6}$ and ~ 330 ergs per c.c. Detailed results and curves for pure annealed and hard-drawn Ni and Ni-Fe alloys, strained and unstrained, are given, effectively proving Warburg's law and enabling a detailed analysis of the energy changes accompanying magnetisation to be made. They accord with Becker's views on magnetisation processes in ferromagnetics, but do not support Preisach's conception of the formation of demagnetisation nuclei in the case of very soft ferromagnetics. N. M. B.

Ferromagnetism and its carrier in the system manganese-bismuth. K. Thielmann (*Ann. Physik*, 1940, [v], 37, 41—62).—Mn powder reacts with molten Bi at 272—600° in the absence of air to give a ferromagnetic material, generally in powder form. Analysis of a magnetic extract of the powder shows indirectly that the ferromagnetic constituent is BiMn. Debye-Scherrer photographs of suitably prepared compacted specimens show that BiMn has a NiAs structure with a 4.26 , c 0.07 , a , c/a 1.42 , V 95.3 , cu. A. A method of preparing the alloys in rod form, and an improved Weiss apparatus for their magnetic examination, are described. The effect of heat-treatment on the enrichment of BiMn is studied by magnetic and microscopical methods. The hysteresis loop shows saturation at $\sim 10^4$ gauss. The magnetisation rises slowly between 250° and 30°, and then more rapidly, and reaches a max. at $\sim 180^\circ$; this temp.-dependence and the Curie temp. ($343 \pm 2^\circ$) are approx. independent of the Mn content of the alloy. BiMn has a saturation moment of 3.13 Bohr magnetons, probably due to the Mn atom. BiMn is compared with analogous P, N, As, and Sb compounds. A. J. E. W.

Dissociation of hexaphenyldiplumbane. R. Preckel and P. W. Selwood (*J. Amer. Chem. Soc.*, 1940, 62, 2765—2766).—Sp. magnetic susceptibility, χ , and ρ have been measured for Pb_6Ph_6 in C_6H_6 between 30° and 80° and at 0.01547 and 0.02265M. The upper limit of dissociation is calc. as 1.4% compared with 0.1% for the solid state. The dissociation into $PbPh_3$, which would be paramagnetic, is unlikely (cf. Foster *et al.*, A., 1939, II, 460). W. R. A.

Variation of the magnetic susceptibility of hæmin in various solvents. W. A. Rawlinson (*Austral. J. Exp. Biol.*, 1940, 18, 185—192).—The low magnetic moment of hæmin in purified C_6H_5N is probably due to a small amount of combination between the C_6H_5N and the hæmin. C_6H_5N -parahæmatin gave a magnetic moment of 1.97, which corresponds with one unpaired electron, the six covalent bonds from the Fe atom being arranged octahedrally. When sucrose is added to an alkaline solution of hæmin, the moment rises from 3.6 to 5.6. The magnetic moment of hæmatin in 0.2N-NaOH suggests the presence of intermediate (dsp^2) type of chemical linkings from the Fe atom. D. M. N.

Absorption of sound in carbon dioxide. R. W. Leonard (*J. Acoust. Soc. Amer.*, 1940, 12, 241—244).—Using a direct method for measurements over frequencies 22—112 kc., a microphone responding to sound pressure is moved away from a piston source in a flat surface, the output of the microphone is amplified and recorded photographically, and the resulting pressure-distance curve yields the pressure attenuation coeff. Results accord with theory (cf. Bourgin, A., 1936, 1189). The lowest frequency val. at which μ , the absorption per λ , is a max. is 30 kc. This max. is accounted for by assuming that the symmetrical valency vibration and the deformation vibration are effective in producing the absorption, and that the second harmonic of the deformation mode also participates in the absorptive process. Velocity measurements show a reasonable agreement between dispersion and absorption. N. M. B.

Absorption of sound in five triatomic gases. E. F. Fricke (*J. Acoust. Soc. Amer.*, 1940, 12, 245—254).—Measurements of sound absorption coeffs. over 8—130 kc. for CO_2 , N_2O , COS , CS_2 , and SO_2 are reported. The frequencies of max. absorption are 20, 153, 287, 379, and 1040 kc., respectively. For the linear mols. CO_2 , N_2O , COS , and CS_2 , a linear relation exists between the max. absorption coeffs. and the frequencies at which these max. occur. Other acoustic relationships are described. Reaction rates, probabilities of removal of

vibrational quanta, the no. of collisions necessary to remove energy quanta, and the no. of quantum transitions per sec. are calc. A technique for finding the frequencies of max. absorption at frequencies beyond the scope of the apparatus is presented. N. M. B.

Absorption of sound in carbon dioxide, nitrous oxide, carbonyl sulphide, and carbon disulphide containing added impurities. V. O. Knudsen and E. Fricke (*J. Acoust. Soc. Amer.*, 1940, 12, 255—259, cf. preceding abstract).—The addition of certain gases, such as H_2 , H_2O , H_2S , $MeOH$, etc., as "catalysts" shifts the absorption bands to higher frequencies, and the magnitudes of the shifts yield information regarding the frequency at which each pure gas has its max. absorption, the nature of the mol. collisions involved, and the effectiveness of the collisions in disturbing the vibrational states of the absorptive mols. Results show that at atm. pressure and 23° the absorption max. for pure CO_2 , N_2O , COS , and CS_2 are shifted in each case by amounts α the concn. of the added catalyst. Transition probabilities for the gases are calc., and these are characteristic of the colliding pair of mols. N. M. B.

Properties of thin metal layers. Y. Saito (*Electrotech. J.*, 1938, 2, 171; *Chem. Zentr.*, 1938, ii, 3373—3374).—The transparency of thin sputtered Au films passes through a max. as the thickness (a) increases. The electrical resistance reaches a limit with $a < a$ crit. val. A. J. E. W.

Determination of the refractive index of iron by the Kundt prism method. A. Boettcher (*Ann. Physik*, 1940, [v], 37, 278—290).—The prep. of thin Fe prisms by condensation on glass in a vac. is described; the prismatic cross-section is secured by a moving diaphragm in front of the cooled surface. In the apparatus used the prism and refraction angles are determined by microphotometer measurements on photographed cross-wire images. The n vals. obtained are 2.80 ± 0.02 , 2.52 ± 0.05 , and 2.15 ± 0.09 at 5780, 5460, and 4350 Å., respectively. A. J. E. W.

Optical constants of thick metal layers in the visible and near infra-red. R. Kretzmann (*Ann. Physik*, 1940, [v], 37, 303—325).—A new apparatus for the direct determination of the principal angle of incidence ($\bar{\phi}$) and principal azimuth ($\bar{\psi}$) of thick metal films is described; light from a monochromator is reflected through a system of four similar films on glass or quartz, and the intensity is measured with a photo-cell. The prep. of the films by evaporation is described; their thickness is measured from Newton's rings. Cu, Ag, and Au films have been studied at 5000—10,000 Å. With Cu, and to a smaller extent with Ag, $\bar{\phi}$ and $\bar{\psi}$ vary with the rate of deposition of the film, a rapidly deposited film giving higher vals. $\bar{\phi}$ and $\bar{\psi}$ for a film of given thickness do not vary with the no. of successively deposited layers used to build up the film. The dispersion variations are identical for films on glass or quartz, but with Cu and Ag $\bar{\phi}$ and $\bar{\psi}$ are slightly higher for quartz; larger differences occur with Au. Dispersion and absorption data for the films are calc. A. J. E. W.

Optical properties of phenylthiocarbamide derivatives. (Miss) M. L. Willard and (Miss) M. Z. Jones (*J. Amer. Chem. Soc.*, 1940, 62, 2876—2877).—Optical properties (crystal habit, extinction, optic axial angles, n_a , n_β , and n_γ) for 13 derivatives of phenylthiocarbamide are recorded. From these data members of homologous series, having nearly identical m.p., may be distinguished. W. R. A.

Heat capacities of some organic compounds containing nitrogen and the atomic heat of nitrogen. II. S. Satoh and T. Sogabe (*Bull. Inst. Phys. Chem. Res. Japan*, 1940, 19, 1244—1250).—Comparison of the mol. heats of $BzOH$, $CHPh:CH:CO_2H$, $p-NH_2 \cdot C_6H_4 \cdot N:NPh$, antipyrine, and $PhSO_2 \cdot NH_2$ with those of their NH_2 -derivatives yields a mean val. of 4.04 g.-cal. for the at. heat of N, comparable with the val. 4.22 found with NO_2 -compounds. No marked regularity is found in the vals. for *o*-, *m*-, and *p*-derivatives, but the val. in $CHPh:CH:CO_2H$ derivatives is $>$ in $BzOH$ derivatives. J. W. S.

Change of thermal expansion and electrical resistance of γ -manganese on transformation into the α -form. H. D. Erling (*Ann. Physik*, 1940, [v], 37, 162—168).—The mean coeffs. of linear expansion (β) of γ -Mn (for method of prep. cf. Herrmann, A., 1941, I, 53) and α -Mn at 0—20° are 14.75 and 22.29 $\times 10^{-6}$, respectively. Except at low temp. the vari-

ation of β with T for α -Mn can be represented by a Debye temp. (Θ) of 460° ; Θ for γ -Mn is probably $<400^\circ$. The sp. resistances (ρ) for γ - and α -Mn are 0.39 and $6.3 \times 10^{-4} \Omega$ per cm. cube, with temp. coeffs. between 0° and room temp. of 0.00628 and 0.000215 . The changes of β and ρ during the γ - α transformation are recorded. A. J. E. W.

Geometrical note on van der Waals' equation. H. Bagchi (*Indian J. Physics*, 1940, 14, 173—185).—Van der Waals' equation has been studied mathematically in Euclidean space of three dimensions. W. R. A.

Gas imperfection. I. Determination of second virial coefficients for seven unsaturated aliphatic hydrocarbons. E. E. Roper (*J. Physical Chem.*, 1940, 44, 835—847).— P - V - T data over the range $\sim 340^\circ$ K. down to the normal b.p. have been obtained for C_2H_4 , C_3H_6 , $C(CH_3)_2$, $CH_2=CMc_2$, $CH_2=CHEt$, and *cis*- and *trans*-($CHMe$) $_2$. The observed vals. for the mol. vols. show a mean deviation of $\pm 0.06\%$ from calc. vals. The dependence on T of the second virial coeff. (θ) in Onnes' equation of state is shown graphically, and vals. for the consts. f , g , and h in the equation $\theta = f + g/T + h/T^2$ have been calc. C. R. H.

Generalised high-pressure properties of gases. K. M. Watson and R. L. Smith (*Nat. Petroleum News*, 1936, 28, No. 27, 29—30, 32, 34—36).—Compressibility, fugacity, heat content, heat capacity, heat of dissolution, and expansion data are summarised. Ch. Abs. (e)

Phenomenological significance of thermodynamic constants. V. Njegovan (*Acta phys. polon.*, 1937, 6, 109—129; *Chem. Zentr.*, 1938, ii, 3520).—A theoretical discussion, chiefly of the significance of internal pressure in gases and liquids. A. J. E. W.

Theory of fusion. J. G. Kirkwood and (Miss) E. Monroe (*J. Chem. Physics*, 1940, 8, 845—846).—Mathematical. A theory of fusion is based on the concept of an order-disorder transformation. J. W. S.

Viscosity of carbon dioxide in the critical region. S. N. Naldrett and O. Maass (*Canad. J. Res.*, 1940, 18, B, 322—332).— η for CO_2 in the region of the crit. temp. has been studied with an oscillating-disc viscosimeter. Equilibrium vals. are rapidly reached when the temp. is lowered, but with rising temp. from below to above the crit. temp. there is a pronounced time lag. In the region above the crit. temp. there is no min. of the η - T isochores, and η is more dependent on p than on T . The interpretation of these results is discussed. F. J. G.

Combined stress and anisotropy. J. J. Guest (*Phil. Mag.*, 1940, [vii], 30, 349—369).—Theoretical. The effect of anisotropy on the yield point is discussed, and the results of Mason (*Proc. Inst. Mech. Eng.*, 1900, 1206), Becker (*Ill. Univ. Eng. Dept. Bull.*, 1916, 84), and Cook (*Proc. Roy. Soc.*, 1932, A, 137, 559) are interpreted as in close agreement with the Guest criterion of elastic failure. O. D. S.

Theory of elasticity of non-isotropic materials with applications to the problems of bending and torsion. E. Reissner (*Phil. Mag.*, 1940, [vii], 30, 418—427).—Mathematical. The two-dimensional theory of elasticity of materials of rectilinear anisotropy and its applications are presented, with the simplifications due to the fact that one of the two elastic moduli occurring in plane stress is assumed to be zero, i.e., the material is not resistant to normal stresses in a certain direction. O. D. S.

Plasticity of the isotropic body. Y. Nakagawa (*Mem. Ryojun Col. Eng.*, 1940, 13, 22—193).—Mathematical. F. L. U.

V.—SOLUTIONS AND MIXTURES (INCLUDING COLLOIDS).

Solidification-point curves of binary [fatty] acid mixtures. II. Palmitic, stearic, arachidic, behenic, lignoceric. H. A. Schuette and H. A. Vogel (*Oil and Soap*, 1940, 17, 155—157; cf. B., 1940, 222).—The f.p. curves (illustrated) for binary mixtures of consecutive pairs of the above acids show 3 segments with two breaks at positions corresponding with 48 and 73 mol.-%, respectively, of the acid of lower mol. wt., and are interpreted as indicating the formation of one equimol. binary compound between each adjacent pair of acids. The tendency of the curves to approach a smooth continuous form

as the mol. wt. of the acids increases suggests a decreasing tendency in the higher acids to compound formation. E. L.

Action of non-electrolytes [on electrolytes]. P. Z. Fischer (*Bull. Sci. Univ. Kiev*, 1939, No. 4, 197—208).—A review. R. T.

Density, heat capacity, and compressibility of solutions of electrolytes. V. K. Sementschenko (*Uspechi Chim.*, 1936, 5, 641—661).—A review. Ch. Abs. (e)

Stationary and non-stationary states of flow of hydrogen in palladium and iron. R. M. Barrer (*Trans. Faraday Soc.*, 1940, 36, 1235—1248; cf. A., 1939, I, 317, 466; 1940, I, 355).—A method depending on measurement of the time lag L in establishing a steady state of flow was used to determine diffusion coeffs. D of H in Pd and Fe; the derivation of a relation between L and D for cylindrical tubes is given. Vals. of D and of the permeability P were determined for Pd from room temp. to 350° and for Fe from 0° to 80° . Vals. of the consts. in the expressions $P = P_0 e^{-E/RT}$ and $D = D_0 e^{-E_d/RT}$ are given. When phase-boundary reactions are rate-controlling the curve of permeation rate against $\sqrt{c.d.}$ (for H produced by electrolysis at a Pd or Fe cathode) has a "foot" at low c.d. but becomes straight at high c.d.; this behaviour is accounted for by combined phase-boundary reactions and diffusion, and is not due to adsorption effects. With suitably activated Pd, phase-boundary reactions are eliminated, and permeability may then be increased 2500-fold, and the rate is independent of c.d. F. L. U.

Alloys of aluminium and lead. A. N. Campbell and R. W. Ashley (*Canad. J. Res.*, 1940, 18, B, 281—287).—The system Al-Pb has been studied by means of cooling curves and photomicrography. The mutual solubility is inappreciable in the solid state and small in the liquid state at $<800^\circ$, but liquid Al can take up $>10\%$ of Pb into colloidal suspension. There is a eutectic at 326.8° with 0.021% of Al, and an invariant point with solid Al and two liquid layers at 658.5° , the Al-rich liquid having 98.9% of Al. Small additions ($>0.7\%$) of Pb increase the hardness of Al; larger amounts diminish it. F. J. G.

Solubility measurements in the region of the critical temperature. C. H. Holder and O. Maass (*Canad. J. Res.*, 1940, 18, B, 293—304).—Apparatus is described by means of which samples may be taken from either phase of a liquid-vapour system without disturbing the equilibrium. The solubility of C_2Cl_6 in the liquid and vapour phases of C_2H_6 in the region of the crit. temp. has been determined. A difference in the solubility, and also in p , between the upper and lower parts of the vessel persists above the crit. temp. F. J. G.

Solubility of sucrose. G. Verhaar (*Arch. Suikerind. Nederl.-Indië*, 1940, 1, 325—334).—The solubility in H_2O at 30° is 68.4 g. in 100 g. of solution, and is independent of the crystal size. Supersaturated solutions reach equilibrium only very slowly (>20 hr.). Previous work is discussed critically. S. C.

Aromatic sulphonic acids as reagents for amino-acids.—See A., 1940, II, 365.

Soap oleosols. I. Dissolution of soap in hydrocarbons. G. E. Levant and E. L. Alperovitch (*Kolloid. Shurn.*, 1939, 5, 493—500).—The solubilities of numerous steates in a hydrocarbon oil have been measured at 0 – 160° . For the soaps of bi- and ter-valent metals, except Ca and Ba, the solubility rises with temp. and ultimately there is complete miscibility. The solutions show marked supersaturation and appear to be lyophilic sols. R. C.

Distribution of isomorphous salts in solubility equilibrium between liquid and solid phases. A. E. Hill, G. S. Durham, and J. E. Ricci (*J. Amer. Chem. Soc.*, 1940, 63, 2723—2732).—The distribution data for the equilibrium between solid solutions of alums or picromerites and their aq. solutions are represented empirically by $\log R_s = \log K + m \log R_a$, where K is the true distribution const. in terms of activities and m is a const. characteristic of each system and related to the attraction or repulsion between the two components in the solid phase. By comparing this equation with the theoretical equation, $\log R_s = \log K + \log R_a(f_1/f_2)$, the relationship, $a_1 = kx_1^m$, between the activity, a , the mol. fraction, x , of a component, and m has been established. The three Roozeboom types of distribution for ternary solutions forming continuous solid solutions are related to the val. of m ; type I

has $m = 1$ and alums belong to this class; picromerites with $m < 1$, i.e., positive deviations from ideality, belong to type II, whilst type III, showing negative deviations from ideality, has $m > 1$. The distribution const., R_1/R_2^m generally agrees well with vals. calc. from solubilities using an empirical regularity observed for the activity coeffs. of sulphates in the ionic strengths involved. W. R. A.

Isotherms of adsorption and of surface tension. A. K. Skrzabin (*Kolloid. Shurn.*, 1939, 5, 831–842).—The adsorption isothermal is expressed by the equation $A = (A_\infty - A_0) \tanh K(c - c_0) + A_0$, A being the amount adsorbed, A_∞ the max. adsorption, c the concn., and A_0 , K , and c_0 consts. J. J. B.

Recovery of nitrous gases by adsorption. I. Adsorption of nitric oxide by silica gel. E. Briner and B. Sguaitamatti (*Helv. Chim. Acta*, 1940, 23, 1216–1231).—The adsorption on SiO_2 gel of NO has been studied at -78° , 0° , and 50° , of O_2 at -78° and 0° , and of CO_2 at 0° and 50° . The Freundlich equation is not applicable to the results with NO and O_2 at -78° or with CO_2 at 0° . At equal temp. and pressure, NO is more strongly adsorbed than O_2 but less strongly adsorbed than CO_2 . SiO_2 gel containing adsorbed NO is olive-green at 0° , and becomes garnet-red at -78° and almost black at the temp. of liquid air. The reason for these colours is discussed. The increase in the velocity of reaction of NO with O_2 in SiO_2 gel is attributed to the high adsorption of the gas. J. W. S.

Adsorption of water vapour on silica surfaces by direct weighing. H. M. Barrett, A. W. Birnie, and M. Cohen (*J. Amer. Chem. Soc.*, 1940, 62, 2839–2844).—The adsorption of H_2O vapour at 30° on powdered fused SiO_2 , 230–270-mesh, has been determined between 0.01 and 26 mm. by means of an improved micro-balance of high sensitivity. Two types of adsorption were encountered, one rapid and reversible, the other slow and irreversible. Treating the SiO_2 with dil. HNO_3 reduced the reversible adsorption by 35% and a further reduction of 30% occurred on heating. The approx. area of powders was estimated by the method of Kenrick (cf. B., 1941, I, 46). The reversible adsorption is determined as a 0.1-mol. layer at 1 mm., becoming unimol. at 23 mm. Measurements of adsorption rates indicate that the process resembles diffusion of H_2O into the SiO_2 . W. R. A.

Adsorption of ethylene on reduced nickel. S. Iijima (*Bull. Inst. Phys. Chem. Res. Japan*, 1940, 38, 1261–1270).—The velocity of adsorption of C_2H_4 on reduced Ni, and the total amount adsorbed, have been studied between -95° and 200° . Below -63° and above 150° adsorption equilibrium is established in a few min., but at intermediate temp. requires longer. The author's formula is applicable to the rate of adsorption at the stage when activated adsorption occurs. The heat of adsorption calc. from the adsorption isotherm at low temp. is 5.6 kg.-cal. This is attributed to van der Waals adsorption. Freundlich's adsorption isotherm can be applied satisfactorily to the observed vals., but the log a -log p diagram contains a break. Langmuir's isotherm is not applicable, whilst Williams' formula is applicable only at low temp. J. W. S.

Application of the hydrogen-bridge theory to sorption from solution by silica gel. A. L. Elder and R. A. Springer (*J. Physical Chem.*, 1940, 44, 943–949).—Data for the sorption by SiO_2 gel of several org. acids from solution in H_2O and org. solvents are presented. Sorption diminishes as the no. of C atoms in the acid increases and with change in solvent, viz., $\text{CCl}_4 > \text{PhMe} > \text{PhNO}_2 > \text{dioxan} > \text{H}_2\text{O}$. H-bridging between acid and SiO_2 is able in part to explain the data but mol. size and the relative extent of H-bridge formation by solvent and solute must also be taken into account. The effect of mol. size is illustrated by the tendency to form H-bridges, viz., $\text{HCO}_2\text{H} > \text{AcOH} > \text{EtCO}_2\text{H} > \text{palmitic acid (I)}$, being in the same order as the extent of sorption. BzOH , however, lies between HCO_2H and AcOH in its tendency to form H-bridges but lies between EtCO_2H and (I) in its extent of sorption. C. R. H.

Adsorptive properties of synthetic resins. IV. S. S. Bhatnagar, A. N. Kapur, and M. S. Bhatnagar (*J. Indian Chem. Soc.*, 1940, 17, 361–369; cf. A., 1939, I, 608).—The % adsorption of aliphatic acids from aq. solution by acid-condensed phenolic resins increases with increasing mol. wt. of the acid but the opposite behaviour occurs with alkali-condensed resins and with NH_2 - and protein-resins. A similar reduction in adsorption with increasing mol. wt.

occurs even with acid-condensed resins when the acids are dissolved in non-polar solvents. The % adsorption increases with decreasing dipole moment of the solvent. These facts can be explained on the Langmuir-Harkins theory of surface orientation by assuming that the acid phenolic resins are less polar whilst the other resins are more polar than H_2O . With the former resins the polar CO_2H of the acid will tend to orient more towards H_2O , but as the mol. wt. of the acid increases it will be more difficult to pull the longer chain into H_2O and the balance of distribution of the acid between H_2O and resin will shift towards the resin. This explanation is further strengthened by data for the relative adsorption of *cis*- and *trans*-dibasic acids. Substitution into the acid of CO_2H , OH, CN, Cl, and Br increases, whilst substitution of NH_2 and alkyl groups decreases, the % adsorption by NH_2 - and protein-resins. C. R. H.

Density of sorbed and bound liquids. I. Density of water bound by starch. A. Z. Kotukov (*Kolloid. Shurn.*, 1939, 5, 373–378).—For H_2O bound by starch, d falls from 1.81 to 1.36 with increase of the degree of hydrophilism from 0.15 to 0.25. R. C.

Ageing and coprecipitation. XXXIII. Thermal ageing of imperfect barium sulphate. I. M. Kolthoff and W. M. MacNevin (*J. Physical Chem.*, 1940, 44, 921–935).—When physically and chemically imperfect BaSO_4 is heated the H_2O which is slowly but quantitatively driven off is occluded, not adsorbed H_2O . When dried BaSO_4 is exposed to H_2O vapour it adsorbs H_2O , the thickness of the adsorbed layer increasing with the relative vapour tension. Heating of BaSO_4 decreases the sp. surface and it is shown that the sp. surface can be calc. from the amount of H_2O adsorbed at a relative vapour tension of 0.57. 1 mg. of H_2O adsorbed at this vapour tension corresponds with a sp. surface of 10^{19} Ba ions and an average particle size of 0.66μ . Thermal ageing is slow at temp. $< 300^\circ$, pronounced at 500° , and very rapid at temp. $> 700^\circ$ when it is accompanied by rapid crystallisation as a result of the combined effects of sintering and the thermal mobility of the ions. Crystallisation is accompanied by the elimination of foreign materials (e.g., NaCl) which do not fit into the lattice. Occluded H_2O has no effect on the speed of ageing. C. R. H.

Influence of sorbed vapour on the static hysteresis of wetting. M. V. Tschapek and N. B. Kretschun (*Kolloid. Shurn.*, 1939, 5, 763–766).—The contact angle between H_2O and a mineral in air is increased by a thorough drying of the mineral before the experiment; the vals. for dried and air-dry surfaces were respectively 135° and 52° for quartz, 100° and 60° for calcite, 180° and 135° for limonite, and 92° and 45° for hornblende. A drop of H_2O in paraffin oil on dried graphite gave 125° , and a drop of paraffin oil in H_2O 55° ; the difference was $>$ for air-dry surfaces. J. J. B.

Surface tensions of amino-acid solutions as a function of p_H . J. W. Belton and A. H. H. Twiddle (*Trans. Faraday Soc.*, 1940, 36, 1198–1208).—Surface tensions of aq. glycine (I), alanine (II), valine, cystine, and hippuric acid were measured at 25° in the p_H range 0–12. The γ - p_H curves for const. amino-acid concn. all possess one or two max. and min. For acids which increase the γ of H_2O [(I) and (II)], the p_H of the pure aq. acid corresponds with a point on the curve between a max. and a min., whilst for the remaining acids, which depress the γ of H_2O , this p_H corresponds with a min. or max. γ . The thermodynamic theory of the systems is given, and the surface excess of the various components corresponding with different portions of the curves is calc. The influence of NaCl on the behaviour of (I) and (II) solutions was also examined. F. L. U.

Theory of non-dissolving volume [negative adsorption]. B. V. Derjaguin (*Kolloid. Shurn.*, 1939, 5, 605–611; cf. A., 1941, I, 10).—The "non-dissolving" vol. ϕ depends on the concn. c of the "indicator" (i.e., the negative adsorption Γ of a solute depends on its concn.). The theory based on Bakker's theory of surface tension leads to the equations $\phi = \epsilon + C\epsilon^{-p_\epsilon}$ (ϵ and C are const., and V is the mol. vol. of the solvent) and $\Gamma = -\phi$. The equation for ϕ seems to agree with the experiments. J. J. B.

New technique of electrocapillary measurements. J. Jackson (*Trans. Faraday Soc.*, 1940, 36, 1248–1252).—The method described minimises the error due to the ohmic potential drop in the column of solution in the end of the capillary; it also permits more rapid measurements. F. L. U.

Monolayers of compounds with branched hydrocarbon chains. II. Effect of substitution on the packing of long hydrocarbon chains. E. Stenhagen and S. Stållberg (*Svensk Kem. Tidskr.*, 1940, 52, 223—233).—Experiments on monolayers of a no. of long-chain org. compounds show that a chain having a small polar group (OH) near the middle lies flat in the surface unless the H on the same C atom is replaced by a larger group (Me), when the mol. assumes a "hairpin" configuration. A larger polar group (CO₂H) increases the tendency to take up this configuration, but it is still only completely attained when in addition the H is replaced by a larger group. These effects are compared with those of substituents on ring-closure and on the dissociation consts. of dibasic acids. F. J. G.

Structure and physico-chemical properties of surface layers of high-molecular compounds. II. Surface properties of agar and starch gels. V. A. Ptscheln (*Kolloid. Shurn.*, 1939, 5, 717—722; cf. A., 1939, I, 256).—The contact angle θ between air, H₂O, and agar was 21° for 3% gel and 73° for air-dry gel. θ between C₆H₆, H₂O, and gels was larger when the gel was first brought in contact in H₂O than when it was first wetted with C₆H₆. The difference (or hysteresis) was 22° for 3% agar gel, 54° for air-dry agar, 3° for starch gel, 46° for air-dry starch, and 111° for 10% gelatin gel. The hysteresis on agar and starch was not affected by the time spent under a liquid before θ was measured. J. J. B.

Pressure-soluble and pressure-displaceable components of monolayers of native and denatured proteins. I. Langmuir and D. F. Waugh (*J. Amer. Chem. Soc.*, 1940, 62, 2771—2793).—Monolayers of egg-albumin, gelatin, zein, insulin, gliadin, pepsin, and edestin, from which unspread mols. in the substrate have been removed by scrubbing, have been studied. Pressures (F), 10—30 dynes per cm. for 10 min., caused certain pressure-sol. components, which were detected and measured by the indicator oil method, to dissolve; this dissolution was accompanied by, and in quant. agreement with, a decrease in area (a) of the layer measured under standard F of 1 dyne per cm. Monolayers from which all pressure-sol. components had been removed by ageing at F 25—30 dynes per cm. formed (F , a) curves with reproducible loops depending on increasing or decreasing F according to a standard F -time cycle. Measurements at $F > 15$ dynes per cm. showed that sudden increases or decreases of F produced only slight changes in a but gradual changes of a larger magnitude followed. It is concluded that the apparent large compressibility of films results from the forcing out from the air-H₂O interface of certain weakly hydrophobic NH₂-acids into a lower film where they contribute little to the surface pressure. This provides, however, a correlation of the compressibility curves of the proteins with their chemical compositions. NH₂-acids with side-chains having a hydrophobicity $<$ that of Et determine the areas in the range F 1—3 dynes per cm., whilst greater hydrophobicity determines the areas at $F = 25$. Films from denatured or partly digested proteins give large amounts of pressure-sol. components, and by observing time changes in (F , a) curves the mol. wts. of the degradation products range from 1000 to 2000. A general theory of pressure-solubility is given and tested by studies of monolayers of aerosols. W. R. A.

Study of the structure of amorphous films by a new electron diffraction method. I. Saturated aqueous solution of zinc chloride. S. Yamaguchi (*Sci. Pap. Inst. Phys. Chem. Res. Tokyo*, 1940, 38, 12—14).—Details are given of results recorded previously (A., 1940, I, 410). J. W. S.

Experimental investigation of laminar systems. Formation of thin films of sulphides of zinc and arsenic on the surface of solutions of zinc and arsenic salts. S. G. Mokruschin and R. B. Ginsburg (*Kolloid. Shurn.*, 1939, 5, 817—822).—5% or 12% H₂S gas diffusing through cotton wool to the surface of a Zn(OAc)₂ or AsCl₃ solution produced films of ZnS or As₂S₃. The ZnS films reached the final thickness in about 5 min.; this thickness had a max. (about 100 Å) in 1N-Zn(OAc)₂. The As₂S₃ films reached the final thickness in 15 min. or more; this increased with concn. to about 3000 Å. The As₂S₃ films appear to be a coagulated sol. J. J. B.

Equilibrium problems in aerosols. I. D. Gurevitch and V. I. Kapustina (*Kolloid. Shurn.*, 1939, 5, 781—795).—Aerosols were prepared in an atm. of a known R.H. and then sucked through sintered glass filters; the concn. of the liquid kept back by the filters was determined. For H₂SO₄

and for NH₄Cl obtained by sublimation this concn. is that which would be in equilibrium with the R.H. at the moment of formation of the aerosol. For H₃PO₄ the observed concn. is $>$ the equilibrium concn. by 10—50%; for NH₄Cl prepared from NH₃ and HCl gases the observed concn. is several times $<$ the equilibrium concn. The NH₄Cl solution probably contained free HCl; the discrepancy for H₃PO₄ presumably was also due to a deviation of the composition from that denoted by the formula. J. J. B.

Factors in the stabilisation of emulsions. A. King and G. W. Wrzeszinski (*J.C.S.*, 1940, 1513—1521).—The effects of electrolytes on the cataphoretic velocities and stabilities of oil-in-H₂O emulsions stabilised by various agents have been studied. Al and Th sulphates at certain concns. reverse the charge of emulsions stabilised by saponin or by Daxad agents, but not of those stabilised by aged Al(OH)₃ or Na oleate. The effects of a given concn. of electrolyte decrease in the order Al₂(SO₄)₃ $>$ Th(SO₄)₂ $>$ MgSO₄ $>$ H₂SO₄ $>$ K₂SO₄ $>$ KOH. The position of the anion in the lyotropic series is of little importance for its effect on the ζ -potential. The electrical charge is not the main condition for stability. Experiments on the behaviour of conc. oil-in-H₂O emulsions stabilised by different agents when treated with salts having anions representative of the two ends of the lyotropic series, and on the effect of these on solutions or dispersions of the emulsifying agents, show that the strength of the adsorbed interfacial film is the main factor in stabilisation. F. J. G.

Properties of polymerides in solution. XVI. Statistical interpretation of the thermodynamic properties of binary liquid systems. K. H. Meyer (*Helv. Chim. Acta*, 1940, 23, 1063—1070).—The departure of the entropy of mixtures containing chain-mols. from the ideal val. is considered theoretically. J. W. S.

Dispersoid and high-molecular systems. A. V. Dumanski (*Kolloid. Shurn.*, 1939, 5, 585—604).—The difference between lyophobic sols, lyophilic sols, and solutions of heavy mols. is discussed. There is an interfacial tension at the micelle/solvent boundary but none at the surface of mols. Large mols. may bind H₂O through their whole vol., not only on the surface. Swelling, viscosity, or osmotic behaviour does not give correct vals. for the bound H₂O. J. J. B.

General law of liquid friction and application to calculation of resistance to motion of disperse systems under isothermal and non-isothermal conditions. I. Connexion between equations of Newton, Maxwell, and Bingham. A. K. Skirjabin (*Kolloid. Shurn.*, 1939, 5, 363—372).—From a mathematical investigation of the relations between these equations it is suggested that liquids may be classified as (i) Newtonian liquids, with $\eta \neq 0$ and the time of relaxation, t , and the initial val. of the modulus of elasticity, θ_0 , both zero, (ii) intermediate liquids, with $\eta \neq 0$, $\theta_0 = 0$, and $t \neq 0$, and (iii) Bingham liquids, with $\eta \neq 0$, $\theta_0 \neq 0$, and $t = \infty$. A generalised law of liquid friction is derived and used to obtain equations for the rates of flow of the various types of liquid through tubes. R. C.

Suspension of solids in mixed liquids. E. W. J. Mardles (*Trans. Faraday Soc.*, 1940, 36, 1189—1198).—Viscosities at high rates of shear and sediment vols. were measured for suspensions of kaolin and other solids in EtOH-Et₂O, EtOH-H₂O, PrOH-H₂O, MeOH-AcOH, NH₂Ph-AcOH, NH₂Ph-oleic acid, and CH₂Ph-OH-cyclohexanone mixtures. The property-composition curves generally present max. or min. Formation of mol. complexes between the liquids often corresponds with a decrease in dispersive action, shown by max. in the η and sediment vol. curves. Thixotropy and high η shown by suspensions in single non-polar liquids are considerably reduced by the addition of a small proportion of a polar substance such as oleic acid or linseed oil, or of a colloid material, such as cellulose nitrate, that is adsorbed by the solid. F. L. U.

Synthesis of hydrosols of sparingly soluble salts by electrolytic method. Lead chromate hydrosols. B. G. Zaprometov, A. I. Kozirev, and A. A. Melnik (*Kolloid. Shurn.*, 1939, 5, 441—448).—The conditions for the prep. of positive and negative PbCrO₄ sols by the electrolytic method (A., 1934, 1305) have been worked out and the effects of protective colloids examined. R. C.

Bound water in iron and aluminium hydroxide sols. E. Schuruigina (*Kolloid. Shurn.*, 1936, 2, 55—60).—Fe(OH)₃ and

Al(OH)₃ sols are shown by refractometric and viscometric studies to be hydrophilic. The amount of bound H₂O decreases on ageing or at higher temp. The results are used to explain the similarity of the hydrophilic properties of the Russian "red" and "black" soils, in spite of large differences in humic acid content. CH. ABS. (e)

Effect of organic compounds on structure formation in sesquioxide sols. I. Effect of tanning substances. II. Effect of proteins and amino-acids. E. I. Kviat (*Kolloid. Shurn.*, 1939, 5, 399—408, 449—460).—I. Tannin, gallic acid, and to a smaller extent pyrogallol and quinol have a sensitising action on Fe(OH)₃ and Al(OH)₃ sols, as indicated by measurements of coagulation threshold and η , and by potentiometric titration. Resorcinol, PhOH, glucose, and mannitol have little effect, whilst BzOH and salicylic acid stabilise at low concns., but sensitise at higher concns. Sensitisation is accompanied by a fall in p_H and is ascribed to complex formation with ions determining the ζ -potential and concurrent displacement of H⁺; there is no attack on the interior of the micelles, apparently because the complexes formed are insol., and protect the surface of the micelles.

II. Ovalbumin (I), peptone, and alanine (II) also form complexes in the above way. (II) forms, however, a sol. complex, and therefore complex formation is not restricted to ions on the surface of the micelles, but penetrates within, leading to disaggregation of the micelles and therefore to stabilisation of the sol. Acidification of the medium increases the amount of ionic Fe able to participate in complex formation. (I) induces intense coagulative structure formation, or even gelation, but after a time there is spontaneous peptisation of such coagulative structures, caused by NH₂-acids formed by hydrolysis of (I). R. C.

Measurement of opacity during the coagulation of concentrated sols of zirconium and stannic hydroxides and the gelation of stannic phosphate and zirconium hydroxide gel-forming mixtures. M. Prasad and K. V. Modak (*Proc. Indian Acad. Sci.*, 1940, 12, A, 235—244).—Opacity changes occurring when Zr(OH)₄ is coagulated by KCl and Sn(OH)₄ is coagulated by KCl and by HgCl₂ at 33° have been followed by a photo-cell method. Both give S-shaped curves with KCl and with higher concn. of KCl the opacity increases suddenly in the early stages of coagulation. In the coagulation of Sn(OH)₄ by HgCl₂ the initial opacity decreases rapidly to a min. val. and then slowly rises. S-shaped opacity curves are also obtained for the gelation of Sn^{IV} phosphate (I) and show that the gelation process is autocatalytic. The influence of the amounts of SnCl₄ and H₃PO₄ in the gel-forming mixtures has been investigated. The opacity-time curves are not influenced by the incident light. Zr(OH)₄ gels give similar opacity-time curves to (I) gels. There appears to be no distinct difference between the processes of gelation and coagulation. W. R. A.

Stabilisation of suspensions by fractions of gelatin and agar. P. M. Lapin and S. M. Liepatov (*Kolloid Shurn.*, 1939, 5, 683—690).—From gelatin and agar fractions were prepared which differed in their tendency to gelate. Fractions gelating easily, especially those prepared by dry heating, reduced the rate of sedimentation of ZnO suspensions more than other fractions; their adsorption, and heat of adsorption, on ZnO powder were also higher. A theoretical explanation of this behaviour is given. J. J. B.

Stabilisation of sols of iron phosphate by blood serum. M. Kolomijteva (*Kolloid. Shurn.*, 1938, 4, 201—204).—The stabilising effect on Fe phosphate sols of cow's blood serum exceeds that of bull's; this difference does not hold for serum-albumin obtained by dialysis of the sera. R. T.

Stabilising and protective action of ferric and aluminium hydroxide sols on suspensions of positively and negatively charged particles. G. V. Zacharova (*Kolloid. Shurn.*, 1938, 4, 191—199).—Aq. suspensions of Fe₂O₃, Al₂O₃, kaolin, MnO₂, talc, S, and chalcedony are stabilised by Fe(OH)₃ or Al(OH)₃ sols, to an extent \propto their concns., up to a limiting val. The sols also protect the suspensions from sedimentation in presence of electrolytes (BaCl₂, NaCl, Na₂SO₄). The effects are ascribed to adsorption of hydrosol particles on those of the suspension, irrespective of the charge of the latter. R. T.

Changes in the aggregation equivalent A and the chloro-aggregation equivalent B of ferric hydroxide sols with dilution.

E. I. Kviat (*Kolloid. Shurn.*, 1938, 4, 217—229).—The equiv. conductivity of Fe(OH)₃ sols rises with dilution; this effect diminishes with increasing thoroughness of dialysis of the sols. It is ascribed to dissociation of HCl in the intermicellar fluid, as well as to dissociation of micelles with liberation of Cl⁻. The dimensions and mobility of the micelles are not affected by dilution. R. T.

Lyotropic effect of ions on structure formation in ferric hydroxide sols. N. P. Kovalevskaja (*Kolloid. Shurn.*, 1938, 4, 209—210).—Development of structural η in Fe(OH)₃ sols depends on presence of ions, the effectiveness of which rises in the series Br < NO₃ < Cl, and K < Na < Mg. The effect is ascribed to micellar dehydration, as well as to modification of ζ -potential. R. T.

Properties of clay suspensions. G. D. Hobson (*J. Inst. Petroleum*, 1940, 26, 533—564; cf. B., 1935, 630).—Flow diagrams are given for a no. of clay suspensions and muds in capillary tubes. The effects on the viscosity of concn., heating, ageing, and mixing samples of different characteristics are recorded and discussed. At high vol. concns. all the suspensions show an increase of η at low rates of flow; one type of clay gives a sigmoid curve in which η increases with increasing rate of flow for intermediate vals. of the latter. In no case does η change with concn. in accordance with Einstein's formula or that of Bingham and Durham (cf. A., 1911, ii, 968); the behaviour of some is represented approx. by the expression $F_g = I_{H_2O} a^{299/(1-c)}$, in which F_g is the fluidity ($1/\eta$) of the suspension, c the vol. fraction of solid, and a a const. Concentric cylinder viscometers are not satisfactory for examining clay suspensions, since in η determinations sedimentation is greatly increased by the rotation, and slipping of the cylinder often occurs during the measurement of yield vals. The latter may be determined satisfactorily by using vanes in place of the inner cylinder. An attempt to estimate the amount of H₂O "bound" by various clays is described. F. L. U.

Effect of the granulometric composition of powders on their ability to bind liquids. I, II. J. M. Gurevitch and M. T. Bereshinskaja (*Kolloid. Shurn.*, 1939, 5, 807—816, 823—829).—I. Ultramarine (I), rouge (II), and Cr₂O₃ (III) were each separated into 4 size fractions of 1—2, 2—5, 5—10, and 10—20 μ . The sedimentation vol. of (I) and (III) in H₂O and linseed oil increased, whilst that of (II) in all liquids and of (I) and (III) in xylene decreased, with diameter. The amount of H₂O, oil, or xylene necessary to form a putty increased with diameter for (I) and (III), and decreased for (II). The viscosity of suspensions of (I), (II), and (III) in paraffin oil, and of (II) in linseed oil decreased, and that of (I) and (III) in linseed oil increased, with diameter. Presumably (II) immobilises at its surface more liquid than (I) and (III) do, whilst in suspensions of (I) and (III) the liquid is trapped between the particles.

II. Mixtures of particles of different sizes were prepared in various ratios. The amount of linseed oil required to produce a putty with (I) increased with the average diameter; it was almost independent of diameter for (II) and (III). The η of linseed oil suspensions was additive for (II) but not for (I) and (III). J. J. B.

Silicic acid gels. X. Time of set of gel mixtures containing high concentrations of mineral acids. C. B. Hurd and R. W. Barclay (*J. Physical Chem.*, 1940, 44, 847—851).—The time of set (t) of SiO₂ gels in presence of HCl or H₂SO₄ increases with increase in p_H over the range 0.5 to —0.5, the plot of p_H against $\log t$ being linear. This behaviour is opposite to that observed over the p_H range 3—6. p_H change causes greater changes in t for gels containing HCl than for those containing H₂SO₄. The energies of activation, 11,000 and 9000 g.-cal. for the two acids respectively, are lower than those observed for the p_H range 3—6. C. R. H.

Silicic acid gels. XII. Time of set of acidic and basic mixtures containing phosphoric acid. C. B. Hurd and A. J. Marotta (*J. Amer. Chem. Soc.*, 1940, 62, 2767—2770).—The effects of temp. and p_H on the time (t) of set of silicic acid (I) mixtures prepared from solutions of Na silicate and H₃PO₄ have been studied. Curves of $\log t$ against p_H at 0° to 49° show linear variation with a flat min. at the neutral point. In acidic mixtures the p_H increases until the gel sets whilst in the basic range the p_H remains const. before and after setting and from this, the calc. activation energy from p_H 0.0 to 10.5 is ~24,700 g.-cal. With increasing p_H t decreases in the acidic

but increases in the basic range. The results were more in accord with the condensation theory than with the coagulation theory for formation of (I) gels. It is concluded that (I) is stronger than has been previously believed. W. R. A.

Surface solubility of clay particles. V. S. Scharov (*Kolloid. Shurn.*, 1939, 5, 571—583).—Behaviour of slurries of clay and H_2O and the electrochemical reactions of clay particles are interpreted in terms of surface solubility. J. J. B.

Influence of the pH of the solution on swelling of clay. A. S. Korshuev and Z. L. Borisova (*Kolloid. Shurn.*, 1939, 5, 667—672).—Swelling of various clays in HCl, NaOAc, buffers, and NaOH was measured. Most clays showed max. swelling in 10N-HCl but kaolin had a max. at pH 14. J. J. B.

Proof of the thermodynamic stability of materials taken up by solutions containing solubilisers such as soap. J. W. McBain and J. J. O'Connor (*J. Amer. Chem. Soc.*, 1940, 62, 2855—2859).—Formation of colloidal solutions of otherwise insol. materials in detergents is accompanied by diminution of free energy and thus the solutions are thermodynamically stable. The v.p. of an insol. volatile liquid taken into colloidal solution by a solubiliser is \ll that of the liquid alone until the solution is approx. saturated. Hydrocarbons, e.g., methylcyclopentane, dissolve in aq. K oleate and in soap solutions containing small amounts of silicate or hydroxide. This solubility is not emulsification, protective action, or true dissolution, but must involve some kind of association with dissolved detergent. W. R. A.

Solubilising and detergent action in non-ionising solvents. J. W. McBain, R. C. Merrill, jun., and J. R. Vinograd (*J. Amer. Chem. Soc.*, 1940, 62, 2880—2881).—Many solubilisers (detergents) which operate in H_2O (cf. preceding abstract) are equally effective in other solvents in which they are sol. This has been tested by adding dyes to $\sim 1\%$ solutions of detergents. The dyes are not dissolved as single mols. and it would appear that association between dye and detergent occurs. A large no. of systems are qualitatively discussed. W. R. A.

Physical chemistry of resin solutions. See B., 1941, II, 18.

Colloid-chemical properties of starch. A. M. Schkodina (*Kolloid. Shurn.*, 1939, 5, 411—417).—The size-distribution curves of various types of potato starch have been determined. Electrolytes accelerate the settling of starch suspensions by coagulative action, apparently through reduction of the H_2O envelopes of the grains. The ζ -potential of starch in H_2O and in aq. solutions of electrolytes has been measured. Starch is negatively charged relatively to H_2O , but addition of sufficient $FeCl_3$ reverses the sign of the charge. The rate of sedimentation increases with fall in the ζ -potential. R. C.

Determination of capillary-condensed water in hydrophilic colloids. M. V. Tschapek (*Kolloid. Shurn.*, 1938, 4, 123—130).—The amount of H_2O adsorbed from aq. EtOH by a given wt. of dry starch or agar does not vary with the $[EtOH]$ from 1 to 70%; that sorbed from air varies according to the R.H. of the latter, being $<$ from 70% EtOH at R.H. < 0.7 . At R.H. > 0.7 , the H_2O bound by the colloids consists of both adsorbed and capillary-condensed H_2O . The amount of the latter is derived from the increase in $[H_2O]$ of 70% EtOH after immersion therein of the given colloid. R. T.

Electrical volume effects on gels and sols of agar. M. S. Schulman and A. M. Karelschadt (*Kolloid. Shurn.*, 1939, 5, 741—748).—By partial dissolution in H_2O agar was separated into three fractions. Their viscosity in H_2O was the higher the less was the solubility. KCl and especially $BaCl_2$ reduced the viscosity. Swelling of agar was reduced by electrodialysis, by KCl, and by $BaCl_2$. J. J. B.

Influence of sugars, alcohols, anions of organic acids, and of pH on the rigidity of agar gels. P. S. Shelezkov (*Kolloid. Shurn.*, 1939, 5, 733—740).—Additions increase the rigidity of 0.5—0.75% agar gels. For 10% additions the increase is 18% for EtOH, 16% for glycerol, 10% for glucose, and 9% for sucrose. In 0.1N. solutions it is 4% for NaOAc, 13% for Na malate, 14% for Na tartrate, and 16% for Na citrate. In presence of citric acid the rigidity has a max. at pH 3.6. Heating for 20 min. at 75° in presence of 0.2% of citric acid reduces the rigidity; this reduction is smaller when EtOH, glycerol, glucose, or sucrose is added. J. J. B.

Relation of freezing to concentration of agar gels. P. S. Shelezkov (*Kolloid. Shurn.*, 1939, 5, 409—410).—The amount

of H_2O separating when a gel of concn. c chilled at a given temp. is allowed to thaw is given by $w = ak^{-c}$, where a and k are const. depending on the experimental conditions and the variety of agar. R. C.

Mechanism of swelling in cellulose. G. S. Kasbekar (*Current Sci.*, 1940, 9, 411—413).—Swelling of cellulose in aq. $ZnCl_2$, $Ca(CNS)_2$, $Zn(CNS)_2$, HCl, HNO_3 , H_2SO_4 , and H_3PO_4 has been investigated. In dil. solution a preferential absorption of solute is observed until the concn. of the solution reaches vals. which cause high swelling. Further, a distinct preferential absorption of salt cations occurs both at low concns. and in the initial stages of swelling at high concns. The formation of hydrocellulose during swelling has been detected. These results indicate the formation of a cellulose-salt or -acid complex which causes the swelling of the cellulose and then its degradation. It is considered that (i) the cellulose mol. combines with the electrolyte to give an oxonium salt, addition occurring at the O bridge linking, (ii) ionisation then occurs giving rise to a diffusible and a non-diffusible ion which causes swelling, and (iii) the non-diffusible ion then reacts with H_2O and, simultaneously, the O bridge is severed leading to the degradation of the cellulose. The proposed mechanism accounts also for hydrolysis by acid or salt catalysis and the observed decrease in ζ -potential with time in acid and salt solutions (cf. A., 1928, 713). W. R. A.

Theory of nitration of cellulose. S. N. Danilov, V. M. Matveev, and V. I. Buchgalter (*J. Gen. Chem. Russ.*, 1940, 10, 527—549).—The system HNO_3 - H_3PO_4 - H_2O consists of anhyd. HNO_3 and hydrated H_3PO_4 when $[H_3PO_4]/[H_2O] > 2$, and of N_2O_5 , anhyd. HNO_3 , and hydrated H_3PO_4 when this ratio approaches 10. No evidence of formation of compounds between H_3PO_4 and HNO_3 is afforded by the v.p., conductivity-, or η -composition diagrams. The N content of nitrated cellulose varies roughly parallel with the v.p. of the nitration mixtures. In the system HNO_3 - H_2SO_4 - H_2O formation of N_2O_5 commences when the ratio $[H_2SO_4]/[H_2O]$ is > 1 . The N content of the nitration product varies almost exactly parallel with the v.p. of the nitration mixtures. Conductivity and η are max. for 1 : 1 : 1 H_2SO_4 - H_2O - HNO_3 mixtures. The NO_2 content of cellulose nitrate depends to some extent on the degree of swelling of the cellulose in the given nitration mixture, for which reasons nitration is less complete in totally anhyd. systems than in those of a low H_2O content. R. T.

Structure and solvation of cellulose nitrate particles. G. V. Liepatova and S. M. Liepatov (*Kolloid. Shurn.*, 1939, 5, 647—654).—Different fractions of cellulose nitrate (I) have in C_6H_6 and $PhNO_2$ different temp. coeffs. of viscosity; this shows that rise of temp. causes breakdown of micelles as distinct from a reduction of solvation. The ratio of the viscosities of two fractions of (I) is independent of the solvent ($COMe_2$, MeOH, $PhNO_2$) for fractions giving low vals. of η ; these fractions may be really dissolved. For other fractions this ratio varies from solvent to solvent, showing the presence of micelles. J. J. B.

Nature of solutions of lyophilic colloids. S. M. Liepatov (*Kolloid. Shurn.*, 1939, 5, 613—638).—Systems like gelatin in H_2O or cellulose nitrate in $COMe_2$ are sols as distinct from solutions. Their colloidal nature is demonstrated by the following facts. (1) The activation energy of the swelling of gelatin is endothermic although the process of solvate formation is exothermic. (2) Dissolution of gelatin produced by long heating is not reversible; low-mol. fractions formed during heating protect high-mol. ones. (3) Gelatin sols age to sols having structure, then to gels, and in gels syneresis takes place. Kruyt's theory of solvation does not account for this change since it fails to discriminate between internal and external solvation. Adsorption of low-mol. fractions can stop the ageing. (4) The size of micelles varies with the solvent; solvation alone cannot explain the different effect of solvents on viscosity and osmotic pressure of sols. J. J. B.

Solvation of proteins in aqueous solutions of weak acids and bases. I. Interaction of casein with aqueous solutions of acetic, lactic, and citric acids. V. A. Vilenski and A. J. Korolev (*Kolloid. Shurn.*, 1939, 5, 843—849).—Casein sols were separated from acid solutions by a collodion membrane. The total concn. of the acid was determined before the experiment and after equilibrium was reached, and the pH of the casein and of the acid solutions was measured. From these data the adsorption by casein of undissociated acid is

calc. In most cases it is $>$ the amount of acid anion bound by casein cations. J. J. B.

Physico-chemical properties of the outer surface of protein fibres, in connexion with the affinity for water of their interior. V. A. Ptschelin (*Kolloid. Shurn.*, 1938, 4, 241—248).—The affinity for H_2O of the outer layer of various materials varies in the order cellulose $>$ collagen $>$ hoof keratin = silk $>$ hair = feather. For the inner mass the order is filter-paper $<$ cotton-wool $<$ silk $<$ hoof keratin $<$ wool $<$ feather keratin $<$ rabbit's hair $<$ collagen $<$ mole's hair. R. T.

Anomalous dispersion as a method of investigating colloidal systems. A. V. Dumanski and M. S. Barvinok (*Kolloid. Shurn.*, 1939, 5, 639—645).—The radius of protein micelles, supposed spherical, may be calc. from the dispersion of the dielectric const. J. J. B.

Thermal denaturation of proteins. R. V. Rishova (*Kolloid. Shurn.*, 1938, 4, 149—155).—The heat of sorption of water and the sorptive capacity of native serum-globulin exceed those of the heat-coagulated product. Thermal denaturation consists in desorption of a thermostable, sol. fraction of high NH_2 -content, with micellar aggregation and desolvation of the thermolabile fraction. R. T.

Physical chemistry of thermal denaturation of proteins. I. Interaction of denatured and native ovalbumin with hydrogen and hydroxyl ions. A. P. Saltschinkin (*Kolloid. Shurn.*, 1939, 5, 467—473).—From measurements of the fixation of HCl from aq. solution it is found that the electrochemical equiv. is reduced by denaturation. R. C.

Colloid-chemical hydrolysis of proteins. III. S. I. Djatschkovski (*Kolloid. Shurn.*, 1939, 5, 501—515).—The Et_2O and C_6H_6 fractions of ovalbumin and casein extracted by emulsification have been examined analytically. The cyclic and aliphatic constituents of the proteins are distributed fairly uniformly between both fractions, but the carbohydrate components such as diglucosamine are to be found in the Et_2O fraction. Conductometric titration indicates that both fractions are richer in basic NH_2 -groups than are the original proteins, and measurement of the hydration shows that they are also enriched in hydrated constituents of the proteins. It is inferred that in the adsorption of Et_2O in the Et_2O emulsification the micelles turn their hydrocarbon radicals towards the Et_2O and their NH_2 -groups towards the H_2O . A method of determining the H_2O of hydration of proteins is described depending on the observation that on drying at a rising temp. the rate of loss of H_2O increases suddenly when H_2O of hydration begins to be lost. R. C.

Dielectric constant of fractions of lyophilic colloids. I. Dielectric constant of gelatin fractions. S. M. Liepatov and M. S. Schulman (*Kolloid. Shurn.*, 1939, 5, 555—566).—Freshly prepared solutions of the fractions have the same dielectric const., ϵ , irrespective of the degree of aggregation, suggesting that association is effected through non-polar groups, a theory also supported by measurement of the effect of temp. on ϵ . For highly polymerised fractions ϵ falls with increasing age by an amount which increases with the concn., but for the therminolysed fraction ϵ is not affected by age. R. C.

Determination of diffusion coefficient of electrolytes into gels from electrical conductivity measurements. N. F. Jermolenko and S. Levina (*Kolloid. Shurn.*, 1939, 5, 483—491).—The diffusion coeff. for the diffusion of KCl from 0.1N. aq. solution into 5% gelatin gel approximates to the val. for diffusion into H_2O . A new method of determining diffusion coeffs. is described. R. C.

Swelling and fractionation of elastic gels. A. V. Dumanski and M. S. Barvinok (*Kolloid. Shurn.*, 1938, 4, 181—190).—The quotient v/Q is const., where v is the increase in vol. of a gel following immersion in H_2O , and Q is the heat effect. Gelatin and starch are separated into more and less sol. fractions (the former by fractional pptn. with $EtOH$, and the latter by electrodialysis). The swelling capacity of the more sol. fractions is \gg that of the less sol. ones, and that of the latter is greatly augmented by presence of the former. R. T.

Laminar systems. Electrophoresis of thin films of metal sulphides and metal hydrates on surfaces of water and solutions. S. G. Mokruschin and Z. G. Scheina (*Kolloid. Shurn.*, 1939, 5, 707—715).—Movement of broken films on a H_2O surface between Pt electrodes was observed. Fresh films of

CuS and well washed films of $Al(OH)_3$, $Fe(OH)_3$, $Zn(OH)_2$, and $Cu(OH)_2$ move to the cathode. Films of As_2S_3 , Sb_2S_3 , Bi_2S_3 , PbS , ZnS , and Ag_2S , and fresh films of hydroxides move to the anode. The rate of movement decreases when the film islets remain on the surface. Particles of paraffin wax are negative. J. J. B.

Electrophoretic study of proteins of egg white. L. G. Longworth, R. K. Cannan, and D. A. Macinnes (*J. Amer. Chem. Soc.*, 1940, 62, 2580—2590).—Electrophoretic patterns of egg white and its known components, obtained by the "schlieren" scanning method and an improved electrophoresis cell over p_H 3—8 at ionic strength 0.1, show in egg white the presence of 7 electrically distinguishable constituents, viz., ovalbumin A_1 and A_2 , ovomucoid O , conalbumin C_1 , and globulins G_1 , G_2 , G_3 . Methods of obtaining, and purifying the known components are discussed. Ovalbumin consists of two constituents both in egg white and in the pure state. Each step in its separation has been followed electrophoretically and indicates the greater efficiency of crystallisation over salting out. Isolation of conalbumin involved a form C_2 which slowly reverted above p_H 4 to the normal form C_1 found in egg white. Ovomucoid was not electrically separable into $>$ one form but showed complexity as indicated by "reversible boundary spreading." A quant. analysis of the composition of egg white by the electrophoretic method is given. The mobilities of the components over the p_H range 3.9—8 at 0° and ionic strength 0.1 are tabulated. Evidence is given for protein-protein complexes especially when the components carry opposite electrical charges, the extent of this association increasing with protein concn. and decreasing ionic strength. W. R. A.

Effect of p_H on sedimentation of clays. A. S. Korshuev and Z. L. Borisova (*Kolloid. Shurn.*, 1939, 5, 475—482).—The pptn. of a clay suspension may take the form of either rapid formation of a ppt. which subsequently increases in vol. owing to gradual coagulation of the disperse part, or of simultaneous pptn. of the whole mass including the disperse part. The effect of the p_H on the pptn. is most marked over the ranges 0.1—2 and 13—14. At p_H 13 the dispersion is almost stabilised. R. C.

Methods of producing periodical structures and determining periodicity constant. F. M. Schemjakin and P. F. Michalev (*Kolloid. Shurn.*, 1939, 5, 655—658).—The paper of Nikiforov and Runtzo (cf. A., 1937, 1, 314) is discussed. J. J. B.

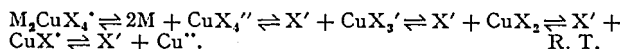
Rhythmic precipitates. I. Electrical study. A. Yanagihara (*Bull. Inst. Phys. Chem. Res. Japan*, 1940, 19, 1251—1260).—The variation of the e.m.f. of an ion concn. cell, comprising two Pt electrodes inserted into a gelatin gel in which rhythmic pptn. of Ag_2CrO_4 is occurring, has been measured with a quadrant electrometer. The effects of change in the concn. of the inner electrolyte, interchange of the inner and outer electrolyte, and the diffusion of the outer electrolyte into a gel containing no inner electrolyte have been investigated. J. W. S.

Limits of periodic stratification. S. S. Charamonenko (*Kolloid. Shurn.*, 1938, 4, 235—239).—The no. of rings forming when aq. $AgNO_3$ is placed on gelatin containing $K_2Cr_2O_7$, or aq. $Pb(NO_3)_2$ on agar containing KI, is limited, being a function of the mol. wt. of the external electrolyte. Knowing this, the no. of rings forming can be predicted, and, conversely, the mol. wt. can be deduced from the no. of rings formed. R. T.

Influence of hydrolysis of gelatin on periodic reactions. S. S. Charamonenko (*Kolloid. Shurn.*, 1939, 5, 755—759).—Periodic pptn. of Ag_2CrO_4 was produced in 3% gel made from gelatin which had previously been boiled for 1, 2, etc. hr. The product of the rate of diffusion and the average distance between bands increased with the time of boiling. Its magnitude may be used for estimating the degree of hydrolysis of gelatin. J. J. B.

VI.—KINETIC THEORY. THERMODYNAMICS.

Complex halides of copper and bismuth. A. K. Babko (*Bull. Sci. Univ. Kiev*, 1939, No. 4, 81—105).—Potentialmetric measurements in the systems H_2O — KCl — CuX_2 and $-BiX_3$ suggest the formation of complexes of the types M_2CuX_4 and $MBiX_4$ ($X = Cl, Br$), dissociating as follows:



R. T.

Cryoscopic study of solutions of electrolytes in presence of non-electrolytes. P. Z. Fischer (*Bull. Sci. Univ. Kiev*, 1939, No. 4, 115—120).—Complexes of the type $[K, \text{non-electrolyte}]Cl(NO_3)$ appear to exist in solutions of KCl or KNO_3 in aq. $CO(NH_2)_2$, mannitol, or sucrose.

R. T.

Dissociation constants, activation energies, and resonance. H. O. Jenkins (*J.C.S.*, 1940, 1447—1453).—The dissociation consts. of monocarboxylic acids and bases, and also the activation energies for the acid hydrolysis of the chloroacetic esters, are discussed with reference to the resonance energies of the ions. The resonance energies are taken to be $\propto n - 1$, where n is the no. of canonical states, and linear relationships between $\log K$ and $\log n$, and between E and n , are indicated.

F. J. G.

Sugar alcohols. XXI. Effect of the anhydrides of sorbitol on the dissociation constant of boric acid. F. K. Bell, C. J. Carr, and J. C. Krantz, jun. (*J. Physical Chem.*, 1940, 44, 862—865).—The titration curves of H_3BO_3 in presence of sorbitol are similar to those in presence of mannitol and dulcitol. The curves for the isosorbide (I)—and sorbitan (II)— H_3BO_3 complexes coincide with those for the isomannide—and dulcitan— H_3BO_3 complexes respectively. This suggests that (I) has a 1:4:3:6-dianhydro- and (II) a 1:4-anhydro-structure. A few conductivity measurements are recorded.

C. R. H.

Dissociation constant measurements on unstable substances. G. Schwarzenbach and K. Lutz (*Helv. Chim. Acta*, 1940, 23, 1147—1162).—An apparatus which permits the determination of the p_H of solutions containing unstable ions is described. The solutions giving rise to the unstable product flow continuously from separate reservoirs and are mixed in a stream of H_2O immediately prior to passing through the glass electrode. Known concns. of Cl^- and I^- , respectively, in the two reservoir vessels permit the calculation of the composition of the mixture from potentiometric titration of the solution issuing from the glass electrode. The method has been applied to the determination of the dissociation consts. of the enolic forms of CH_3Ac_2 , dihydroresorcinol, glutacetic dialdehyde, $CHAc_3$, the base hydrochloride, $C_{11}H_{15}N_2.HCl$, of Thiele and Steimmig (A., 1907, i, 352), and trimethylpyroxonium perchlorate.

J. W. S.

Dissociation constant measurements on mesomeric acids and bases. Resonance energy. G. Schwarzenbach and K. Lutz (*Helv. Chim. Acta*, 1940, 23, 1162—1190).—The dissociation consts. of a no. of mesomeric compounds have been determined by potentiometric measurements, and together with previous data are discussed from the viewpoint of resonance effects in the mols. and ions (cf. A., 1939, i, 263).

J. W. S.

Variation of dissociation constants with temperature. G. Schwarzenbach, H. Suter, and K. Lutz (*Helv. Chim. Acta*, 1940, 23, 1191—1197).—The dissociation consts. (K) of CH_3Ac_2 and dihydroresorcinol (I) have been measured at 20—60°. As with other acids K passes through a max., but in the case of (I) the const. f in Harned and Embree's equation (A., 1934, 732) has a normal val. ($\sim 5 \times 10^{-5}$), whereas with CH_3Ac_2 it is 14×10^{-5} , indicating a more rapid decrease in the heat of dissociation with rise of temp. This is ascribed to changes in resonance energy.

J. W. S.

Effects of certain salts on the dissociation of alanine. II. Cells without liquid-junction potentials. A. C. Batchelder and C. L. A. Schmidt (*J. Physical Chem.*, 1940, 44, 880—892).—The effect of KCl, NaCl, LiCl, and $BaCl_2$ on the dissociation of alanine in acid and alkaline solutions has been investigated and compared with the effects deduced from theoretical considerations. The data recorded supersede those given by earlier experiments in which liquid junctions were present (cf. A., 1940, i, 116).

C. R. H.

Effects of certain salts on the dissociation of aspartic acid, arginine, and ornithine. A. C. Batchelder and C. L. A. Schmidt (*J. Physical Chem.*, 1940, 44, 893—909).—The investigation described in the preceding abstract has been extended to aspartic acid (I), arginine, and ornithine (II). The dissociation curves of alanine, (I), and (II) in NaCl solutions have been calc.

C. R. H.

Activity of the constituents in mixtures of *n*-butyl alcohol and water at 30°. M. Randall and H. P. Weber (*J. Physical*

Chem., 1940, 44, 917—920).—The partial v.p. and activities of the constituents in the mixtures are tabulated. C. R. H.

Electrolyte activities in aqueous solutions. E. Güntelberg (*Kem. Maanedebt.*, 1938, 19, 85—91; *Chem. Zentr.*, 1938, ii, 3519).—"Apparent" and "real" activity coeffs. of ions in aq. solution are distinguished and discussed. An expression derived for the activity coeffs. in mixed solutions (cf. also Guggenheim, A., 1935, 446) is not in accurate agreement with e.m.f. data for reversible cells containing mixtures of aq. $PbCl_2$ and HCl, LiCl, NaCl, or KCl.

A. J. E. W.

Equilibria in the systems $Na_2O-SiO_2-H_2O$ and $Na_2O-Al_2O_3-H_2O$ at 25°. J. W. Sprauer and D. W. Pearce (*J. Physical Chem.*, 1940, 44, 909—916).—Data for the system $Na_2O-Al_2O_3-H_2O$ at 25° confirm those of other investigators at 30° after allowing for the difference in temp. Harman's data for the system $Na_2O-SiO_2-H_2O$ (cf. A., 1927, 519) are not confirmed, the field of stability of $Na_2O.SiO_2.6H_2O$ being at lower $[Na_2O]$ than recorded by Harman. Evidence for the existence of $3Na_2O.2SiO_2.11(?)H_2O$ and possibly lower hydrates is presented.

C. R. H.

Solid solutions of picromerites at 25°. A. E. Hill, G. C. Soth, and J. E. Ricci (*J. Amer. Chem. Soc.*, 1940, 62, 2717—2723; cf. A., 1940, i, 257, 323).—The following systems have been investigated at 25°: $Mg(NH_4)_2(CrO_4)_2-Mg(NH_4)_2(SO_4)_2-H_2O$; $Mg(NH_4)_2(SO_4)_2-Mg(NH_4)_2(SeO_4)_2-H_2O$; $Mg(NH_4)_2(CrO_4)_2-Mg(NH_4)_2(SeO_4)_2-H_2O$; $Mg(NH_4)_2(SeO_4)_2-MgK_2(SeO_4)_2-H_2O$. The pairs of picromerites are completely miscible in the solid states. The systems $MgCrO_4-(NH_4)_2CrO_4-H_2O$ and $MgSeO_4-K_2SeO_4-H_2O$ have also been investigated at 25°.

W. R. A.

Phase behaviour in the methane-propane-*n*-pentane system. R. T. Carter, B. H. Sage, and W. N. Lacey (*Amer. Inst. Min. Met. Eng., Tech. Publ.* 1250, 8 pp.; *Petrol. Tech.*, 1940, 3, No. 4).—The mol. compositions of the system $CH_4-C_2H_6-n-C_5H_{12}$ at 37.8° and at abs. pressures of 200, 500, 1000, 1500, and 2000 lb. per sq. in. are depicted in triangular diagrams. Equilibrium consts. for the components and the compositions of both phases have been evaluated for all pressures except the lowest.

C. R. H.

Condensation of vapour mixtures containing any number of constituents. V. Fischer (*Ann. Physik*, 1940, [v], 37, 63—68).—Expressions are derived by which the progress of condensation of a mixture in a countercurrent condenser may be determined from the conditions for liquid-vapour equilibrium. The method is applied to $n-C_6H_{14}-n-C_4H_{10}-C_3H_8-C_2H_6$ and $n-C_6H_{14}-n-C_4H_{10}-C_3H_8-C_2H_6-H_2$ mixtures, for which K_2 -T diagrams due to Souders, Selheimer, and Brown (A., 1932, 696) are employed.

A. J. E. W.

Heats of dilution of aqueous solutions of glycine and glycollamide; thermodynamic properties of glycine at 25°. F. T. Gucker, jun., H. B. Pickard, and W. L. Ford (*J. Amer. Chem. Soc.*, 1940, 62, 2698—2704).—The heats of dilution of aq. glycine (3.0—0.005M) and glycollamide (6.0 and 0.01M) have been measured at 25°. The relative mol. heat contents (ϕL_2) of each satisfy cubic equations in molality. From heat capacity data cubic equations in temp. are derived for ϕL_2 . The osmotic coeff. of glycine and vals. of standard heat, free energy, entropy of formation, and entropy are given for solid and aq. solution at 25° have been calc.

W. R. A.

Comparative energy states of the azulene and naphthalene nuclei. P. Perrotet, W. Taub, and E. Briner (*Helv. Chim. Acta*, 1940, 23, 1260—1268).—The heats of combustion of guaiazulene (1:4-dimethyl-7-isopropylazulene) (I) (A., 1936, 993) and cadalene (II) (2:5:8- $C_{15}H_8Me_3Pr_3$) are 2022.9 and 1993.4 kg.-cal. per g.-mol., respectively. From these vals. it is deduced that the heats of formation of (I) and (II) from C and H atoms are 929.3 and 958.8 kg.-cal., respectively, and the corresponding heats of formation of azulene and $C_{10}H_8$ 367.2 and 396.7 kg.-cal., respectively. Hence on passing from $C_{10}H_8$ to azulene the bond energy decreases by 8%, in accord with the greater instability of the azulene nucleus and the strains in the ring systems.

J. W. S.

Entropies of large ions. Heat capacity, entropy, and heat of dissolution of potassium chloroplatinate, tetramethylammonium iodide, and uranyl nitrate hexahydrate. L. V. Coulter, K. S. Pitzer, and W. M. Latimer (*J. Amer. Chem. Soc.*, 1940, 62, 2845—2851).—Heat capacities have been measured for K_2PtCl_6 (13.70—299.13° K.), NMe_4I (14.10—297.53° K.),

and $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ (13.67—298.68° K.), yielding for $S^\circ_{298.1 \text{ K.}}$, respectively, 79.78 ± 0.4 , 49.7 ± 0.2 , and 120.85 ± 0.6 g.-cal. per degree per mol. Heats of dissolution are $13,480 \pm 150$, $10,050 \pm 20$, and 5250 ± 20 g.-cal., and free energies of dissolution 6970 ± 200 , 2340 , and -4400 ± 1000 g.-cal., respectively. The partial mol. entropy vals. are respectively 53.2, 50.3, and -17 g.-cal. per degree per mol. The low val. for UO_2^{++} may be due to H_2O attached to the O of UO_2 by H-bonds or, more probably, to the ion being $\text{U}(\text{OH})_4^{++}$. The free energies of formation of PtCl_4^{--} and UO_2^{++} are $-121,500$ and $-229,200$ g.-cal. per mol.

W. R. A.

Thermodynamics and the lowest temperatures. C. G. Darwin (*J. Inst. Elect. Eng.*, 1940, **87**, 581—587).—Kelvin lecture.

VII.—ELECTROCHEMISTRY.

Effect of sorption of water vapour on the conductivity of silica glass. E. V. Ivanova and N. A. Schalberov (*Kolloid. Shurn.*, 1938, **4**, 157—179).—The sp. conductivity of crown SiO_2 glass is $>10^{-17}$ mho. The surface conductivity, κ , of glass is due to adsorbed moisture, and corresponds with that of a layer of pure H_2O containing some dissolved CO_2 , but not containing Na^+ or K^+ . The κ of freshly formed glass surfaces (fracture in vac.) varies roughly parallel with the relative humidity of the air to which they are exposed. The vals. of κ for a given surface diminish with repeated successive adsorptions and desorptions of H_2O ; this is ascribed to formation of a non-adsorbent surface layer of SiO_2 .

R. T.

Conductivity of mixtures of zinc oxide, chromium oxide, and copper. P. Z. Fischer (*Bull. Sci. Univ. Kiev*, 1939, No. 4, 107—113).—Compressed $\text{ZnO}-\text{Cr}_2\text{O}_3-\text{Cu}$ mixtures conduct electricity when the Cu content is $>70\%$. The results are not consistent with the view that the oxides are merely inert diluents.

R. T.

Effect of non-electrolytes on (A) hydrogen over-potential, (B) transport number. P. Z. Fischer and T. E. Koval (*Bull. Sci. Univ. Kiev*, 1939, No. 4, 121—136, 137—141).—(A) The H overpotential developed during electrolysis of $2\text{N}-\text{H}_2\text{SO}_4$ is raised by addition of mannitol (I), $\text{CO}(\text{NH}_2)_2$, glycerol (II), C_6Me_2 , or sucrose. This is ascribed to the extra work involved in decomp. of complexes of the type $[\text{H}_3\text{O}, \text{non-electrolyte}]$.

(B) The val. of the H^+ transport no. falls in presence of the above non-electrolytes, except in the cases of (I) and (II). This is in conformity with the view that electrolytic complexes are formed.

R. T.

Vanadium ion oxidation-reduction potentials. A. B. Hart and J. R. Partington (*J.C.S.*, 1940, 1532—1539).—The cells $\text{Pt}|\text{VO}_2\text{Cl}, \text{VOCl}_2, \text{HCl}|\text{HCl}, \text{Hg}_2\text{Cl}_2|\text{Hg}$ and $\text{Pt}|\text{(VO)}_2\text{SO}_4, \text{VOSO}_4, \text{H}_2\text{SO}_4|\text{H}_2\text{SO}_4, \text{Hg}_2\text{SO}_4|\text{Hg}$ have been studied at 25°. The results are consistent with the view that in acid solution V^{IV} and V^V are present as VO^{++} and VO_2^+ , respectively, and the standard potentials on the H scale of the HCl and H_2SO_4 cells are 0.9992 and 1.0119 v., respectively.

F. J. G.

Relative reducing potentials of starch. R. W. Kerr (*J. Amer. Chem. Soc.*, 1940, **62**, 2735—2738).—Comparison of the relative reducing potentials of 1% solutions of glucose (I), maltose (II), β -amylose (III), and corn starch, and of CH_3O , MeCHO , Pr^nCHO , and Bu^nCHO supports the view that elementary starch mols. are composed of relatively few glucopyranose units. Application of micro-polarographic methods to (I), (II), and (III) demonstrates that current steps exist for (I) and (II). Evidence is submitted for the possible existence of the carbohydrates in the free aldehydic form which may in turn ionise to acid.

W. R. A.

Photovoltaic behaviour of pure silver bromide. H. L. Sanders and I. M. Kolthoff (*J. Physical Chem.*, 1940, **44**, 936—943).—The changes in potential of a membrane-type AgBr electrode when subjected to illumination have been investigated. The potential becomes less positive on illumination and does not completely return to its original val. Agitation decreases both the photopotential and the recovery time after cutting off illumination. This suggests the presence of a sol. reaction product as a result of illumination. The most probable mechanism seems to be a photodecomp. resulting in a free Br atom and an electron. The latter either reacts to produce Ag atoms or takes its place in the lattice according to the "perforated lattice" theory, but in any case it plays

no part in the potential change. The free Br can diffuse into solution giving OBr^+ and Br^+ as a result of hydrolysis. As has already been shown (cf. A., 1937, I, 187), Br^+ make AgBr negative. Positive overpotentials are not observed on account of the absence of free Ag which may be oxidised by Br^+ or OBr^+ .

C. R. H.

Hydrogen overvoltage at high current densities. I. Influence of electrode material, current density, and time, in aqueous solution. A. Hickling, and F. W. Salt (*Trans. Faraday Soc.*, 1940, **36**, 1226—1235).—Measurement of the H overvoltage (η) on various electrode materials in $\text{N}-\text{HCl}$ over a c.d. range of 10^{-3} —1 amp. per sq. cm. by a method previously described (cf. A., 1938, I, 84) shows that Tafel's equation is valid up to the highest c.d. for Bi, Fe, Ni, W, Au, and platinised Pt. With Hg, Cu, Cd, Sn, Al, Pt, Rh, and Pb deviations occur and a general tendency for η to become const. at high c.d. is observed. Vals. of b in Tafel's equation found from the η -log c.d. graphs do not generally agree with the val. required by the assumption that overvoltage is due to the slowness of the reaction $\text{H}^+ + e \rightarrow \text{H}$. Variation of the electrode area does not affect η at const. c.d. The time required for overvoltage equilibrium to be established is markedly reduced by using electrodeposited metals in place of cathodes in massive form.

F. L. U.

VIII.—REACTIONS.

Ignition of inflammable gases by hot moving particles. II. S. Paterson (*Phil. Mag.*, 1940, [vii], **30**, 437—457; cf. A., 1939, I, 475).—Previous experiments are extended to particles moving with lower velocity, 1.2 m. per sec. Ignition temp. T are $<$ those observed at higher velocities but the variation with sphere diameter is similar. No significant effect of mixture concn. was observed for C_2H_{12} -air mixtures ignited by Pt, quartz, and Ni spheres. For a no. of substances, including quartz, Ni, alundum, porcelain, slate, and some metallic oxides and slags, T was independent of the material of the sphere. Polished Pt spheres gave $T \gg$ the other materials. After some use T of the Pt spheres fell to a val. similar to that of the other materials. This change was accompanied by a roughening of the Pt surface. Heating to bright orange in a coal-gas flame restored the polish and the inactivity of the Pt surface. An inactive Pt surface can be activated by heating in air at 1000°. The theories of Silver (A., 1937, I, 247) and Landau (A., 1939, I, 202) are both able to explain the results of the author and others at low speeds but both fail at high speeds where, however, Landau's theory would not be expected to hold.

O. D. S.

Kinetics of thermal decomposition of gaseous silicon tetraethyl and silicon tetrapropyl. C. E. Waring (*Trans. Faraday Soc.*, 1940, **36**, 1142—1153).—The thermal decomp. of SiEt_4 and SiPr_4 in Pyrex vessels at 500—600° is kinetically complex. The primary process, $\text{SiR}_4 = \text{Si} + 4\text{R}$, is predominantly unimol. and is homogeneous. NO has little or no effect on the primary, but in large amounts markedly inhibits the secondary, process, which is considered to be: $\text{R} = \text{C}_2\text{H}_5$ or C_3H_7 , $2\text{H} = \text{H}_2$ (fast), $\text{C}_2\text{H}_4 = \text{CH}_4 + \text{C}$ (slow); and, with SiPr_4 , $\text{C}_3\text{H}_8 + 2\text{H} = \text{C}_2\text{H}_4 + \text{CH}_4$. Chemical analyses were made over the entire decomp. range.

F. L. U.

Macropolymerisation; mechanism of activation. F. P. Irany (*J. Amer. Chem. Soc.*, 1940, **62**, 2690—2698).—Existing mechanisms of macropolymerisation are discussed. It is considered that the conception of the "opening" of a double bond to produce an activated mol. which initiates chain propagation in both directions is inadequate. Two different types of mesomeric virtual free radicals are postulated: a prototropic type A, which is responsible for the initial activation of the chain process in one direction only, and an addend mol. type B. Macropolymerisation occurs by addition of B to A; A then deactivates and B assumes the prototropic form with continuation of propagation. Termination occurs by mutual deactivation of two active chains. B alone can only effect cyclisation. Activation energies of the two types of mesomeric radicals are computed from available data on styrene polymerisation, and hence the reaction consts. of the main phases of the macropolymerisation are calc. The effects of solvents and catalysts are discussed.

W. R. A.

Decomposition of methyl alcohol at high pressures.—See A., 1941, II, 25.

Kinetics of esterification of cyclohexanoic acid and of saponification of its ethyl ester. H. A. Smith and H. S. Levenson (*J. Amer. Chem. Soc.*, 1940, 62, 2733—2735).—Kinetics of the acid-catalysed esterification of cyclohexanoic acid in dry MeOH at 20°, 30°, 40°, and 50°, and of the saponification of its Et ester in EtOH-H₂O (85:15) at 35°, 45°, 55°, and 65° have been studied. Kinetically the behaviour resembles that of Pr^βCO₂H but contrasts with that of substituted acetic acids in accord with theory. W. R. A.

Kinetics of the saponification of esters in dilute solutions. Effect of substitution on the rate-determining factors. H. Shrivastava (*J. Indian Chem. Soc.*, 1940, 17, 387—394).—A kinetic study of the saponification of eleven aliphatic esters R'CO₂R (R' and R vary from Me to C₅H₁₁) indicates that velocity changes are primarily due to changes in the steric factor, although for the early members a progressive increase in E in $K = PZe^{-E/RT}$ has a considerable effect. K decreases as the homologous series is ascended and in general E shows a progressive increase. Vals. of K for isomeric n -esters are approx. equal, but K for the *iso*-isomeride is $< K$ for the corresponding n -isomeride. P is much smaller for esters branched at the α -C than for the n -ester. C. R. H.

Kinetics of mutarotation in solution. J. C. Kendrew and E. A. Moelwyn-Hughes (*Proc. Roy. Soc.*, 1940, A, 176, 352—367).—The mutarotation of reducing sugars from the pentose, hexose, and disaccharide series was investigated polarimetrically over a range of temp. in aq. solution. The velocity coeff. is related to the temp. by a modified form of the Arrhenius equation. The significance of the consts. occurring in the equation is discussed in terms of a theory of unimol. reactions in solution. G. D. P.

Arginase and canavanase.—See A., 1941, III, 136.

Velocity of dissolution of solids. M. Tovbin (*Bull. Sci. Univ. Kiev*, 1939, No. 4, 155—183).—Expressions for the velocity of dissolution of solids are derived, and verified for the cases NaCl and KCl in H₂O. R. T.

Thermal decomposition of nickel formate. A. A. Balandin, E. S. Grigorian, and Z. S. Janischeva (*J. Gen. Chem. Russ.*, 1940, 10, 1031—1041).—At 250° the reactions $\text{Ni} + \text{H}_2 + 2\text{CO}_2 \rightleftharpoons (\text{HCO}_2)_2\text{Ni} \rightarrow \text{Ni} + \text{H}_2\text{O} + \text{CO} + \text{CO}_2$ proceed simultaneously until about half of the formate has decomposed, after which only the former reaction persists. The activation energy of this reaction is 48.1 kg.-cal. per g.-mol., and the reaction is of the $\frac{3}{2}$ order. R. T.

Heterogeneous reaction between chromic sulphate and manganese dioxide. M. Prasad and M. A. Naqvi (*J. Indian Chem. Soc.*, 1940, 17, 370—374).—The reaction between finely-divided hydrated MnO₂ and Cr₂(SO₄)₃ solution is initially very rapid but soon slows down. Cr₂O₃ formation is increased by increasing [Cr₂(SO₄)₃], by raising the temp., and by decreasing the particle size of MnO₂. The reaction is kinetically analogous to the decomp. of NH₃ on heated Pt. C. R. H.

Kinetics of the decomposition reactions of the lower paraffins. VII. Nitric oxide-inhibited decomposition of ethane. E. W. R. Steacie and G. Shane (*Canad. J. Res.*, 1940, 18, B, 351—357).—The NO-inhibited decomp. of C₂H₆ has been studied. As the temp. rises from 565° to 640°, the mean apparent chain-length decreases from 5.0 to 2.4. The activation energy of the inhibited reaction is 77.3 kg.-cal. The products are the same as those of the normal reaction. The reaction proceeds mainly by a radical-rearrangement and not by a free radical mechanism. F. J. G.

Kinetics of the reaction between potassium persulphate and alkyl iodides. III. Catalytic activity of a weak acid. M. S. Telang and V. V. Nadkarny (*J. Indian Chem. Soc.*, 1940, 17, 381—386).—The catalytic coeffs. of H⁺, OAc⁻, and undissociated AcOH have been calc. by three methods from data for the reaction between K₂S₂O₈ and EtI at 50° catalysed by AcOH-NaOAc mixtures. The vals. of the coeffs. obtained by all three methods are of the same order of magnitude. H⁺ and OAc⁻ accelerate, and undissociated AcOH retards, the reaction. Addition of KNO₃ and NaNO₃ to acetate-free AcOH decreases the velocity contrary to the usual "secondary electrolyte effect" for AcOH catalysis. C. R. H.

Kinetics of the olefine-bromine reaction. I. Dark reaction in acetic acid solution. II. Critical increment of the reaction in acetic acid. S. V. Anantkrishnan and R. Venkataraman (*Proc. Indian Acad. Sci.*, 1940, 12, A, 290—305, 306—311).—

I. The bromination of crotonic, tiglic, and $\beta\beta$ -dimethylacrylic acids in glacial AcOH has an induction period which varies with temp. and with concn. of reactants, especially [Br]. The reaction shows several characteristics of a chain reaction involving HBr but a complete mechanism cannot be advanced. The reaction is inhibited by SbBr₃ and catalysed by HBr and by ICl. Under controlled catalytic conditions the reaction gives a bimol. coeff. which varies with the nature of the olefine. A "complex" appears to be formed between the olefine and HBr.

II. At higher temp. the induction period in the uncatalysed reaction between an olefinic acid and Br becomes vanishingly small and in the catalysed reaction thermal activation is much more pronounced. Crit. increments are influenced by group and orientation effects. W. R. A.

Catalytic reduction by means of complex metallic salts. Y. Shibata and T. Yamabe (*Iwata Inst. Plant Biochem.*, 1936, *Publ.* 2, 207—213).—Aq. benzoquinone was reduced by H₂ in presence of [Ni(NH₃)₆]Cl₂, [Ni en]₂Cl₂, [Ni en]₂SO₄, [Ni en]₂(NO₃)₂, and [Ni en(H₂O)]₂SO₄. An initial pressure increase was due to liberation of O₂ from a side reaction in which H₂O₂ was formed. The catalytic activity depended on the structure of the complex, on the anion (SO₄²⁻ and Cl⁻ more effective than NO₃⁻), and on the p_H (optimum 5.6). CH. ABS. (e)

Catalytic action of complex metallic compounds. Y. Shibata and A. Watanabe (*Iwata Inst. Plant Biochem.*, 1936, *Publ.* 2, 97—128).—Sp. metallic complexes attacked polyphenols or aromatic amines analogously to the substrate specificity of the enzymes. Poisoning of catalytic activity was observed, and addition of colloids increased the oxidising action of the complexes. H₂O₂ is formed in the oxidising action. Various metal complexes act as do peroxides; the Co^{II} complex and trinitrotri-amine-Co oxidised the substrate only in presence of H₂O₂. CH. ABS. (e)

Asymmetric oxidation. III. Inhibiting action of some asymmetric organic acids on asymmetric oxidation. Y. Shibata and K. Sakai (*Iwata Inst. Plant Biochem.*, 1936, *Publ.* 2, 190—200).—Oxidation of pyrocatechol by *d*-(I) and *l*-[Co en₂(NH₃)Cl]Br₂ (II) is retarded by *d*-(III) and *l*-tartaric acid (IV), *l*-cysteine (V), and *d*-bromocamphorsulphonic acid (VI). Combinations (I)-(III), (II)-(IV), (I)-(V), and (II)-(VI) are more effective than combinations of opposite optical activity. CH. ABS. (c)

Plant proteases. Kinetic properties etc.—See A., 1940, III, 931.

Hydrogenation by means of hydrogen dissolved in palladium. D. P. Dobuitchin and A. V. Frost (*J. Phys. Chem. Russ.*, 1936, 7, 742—753).—The rate of hydrogenation of C₂H₄ and C₄H₈ at -78° by H₂ previously adsorbed by Pd was $>$ the rate of desorption of H₂, and $>$ the rate of hydrogenation by gaseous H₂ at -78° or 20°. C₂H₄ decreases the rate of adsorption of H₂ by Pd. CH. ABS. (e)

Catalytic addition of hydrogen chloride to ethylene. A. Balandin and O. Livanova (*Utschen. Zapiski*, 1934, 2, 237—239; *Chem. Zentr.*, 1935, ii, 1528).—Addition (62%) of HCl to C₂H₄ in presence of BaCl₂ was measured by the decrease in pressure. Reaction sets in at 210° but dissociation of EtCl occurs at $>300^\circ$. CH. ABS. (c)

Nature of surface of catalytic nickel. W. W. Russell and W. V. Loebenstein (*J. Amer. Chem. Soc.*, 1940, 62, 2573—2580).—Quartz-supported Ni catalysts have been progressively and selectively poisoned by the deposition of C produced by the thermal decomp. of (i) C₂H₄ at 275° for the hydrogenation of COMe₂ at 110°, and (ii) CH₄ at 500° for the hydrogenation of CO₂ at 315° and N₂O at 73.5°. The flow method of measurement has been employed. Catalysts which no longer catalyse the thermal decomp. reactions were still active at lower temp. for the hydrogenation reactions. In the hydrogenation of COMe₂ certain parts of the surface are more active than others. The surface responsible for $\sim\frac{1}{3}$ of the hydrogenation of CO₂ could be poisoned without affecting that part which catalysed the hydrogenation of N₂O. Heating of a surface on which hydrogenation of N₂O had occurred caused selective activation or poisoning according to the conditions employed. It is concluded that the surfaces of the catalysts used are not uniform. W. R. A.

Relative life periods of ethyl alcohol and acetaldehyde molecules on the surface of a copper catalyst. A. Balandin

and A. Bork (*Utschen. Zapiski*, 1934, 2, 217—220).—The dehydrogenation velocity of EtOH in presence of MeCHO on a Cu catalyst was measured. The MeCHO mol. remains on the catalyst surface 5 times as long at 270°, and 3 times as long at 240°, as does the EtOH mol. CH. ABS. (e)

Orientation of molecules of secondary alcohols during dehydrogenation catalysis. A. Balandin, M. Maruschkin, and B. I. Konnikov (*Utschen. Zapiski*, 1934, 2, 221—224).—The rates of dehydrogenation of Pr²OH and cyclohexanol at 230—270° on Cu were the same. Both mols. are attracted to the Cu surface by the OH·CH< group. CH. ABS. (e)

Activation energy in heterogeneous catalysis. G. Rienacker [with H. Wittneben and H. Bade] (*Z. Elektrochem.*, 1940, 46, 369—373).—Activation energies (*A*) of the decomp. of HCO₂H vapour at 150—220° in contact with Bi in different states of subdivision vary from 11.6 kg.-cal. for fine (<0.5 mm.) powder to 24.0 kg.-cal. for single crystals. *A* is greatly increased if the powdered Bi is previously tempered 8 days at 250°. In the same reaction catalysed by Ni the val. of *A* is greatly increased by previous rolling of the metal. From a comparison of the decomp. of HCO₂H and the hydrogenation of C₂H₄ on various compact metal catalysts no relation of activity to other properties of the metal is observable. F. L. U.

[Catalytic] preparation of oxalic acid [from sucrose].—See B., 1941, II, 1.

Catalytic hydrogenation of petroleum fractions.—See B., 1941, I, 11.

Catalytic action of Japanese acid clays on mixtures of aniline and methyl alcohol vapours.—See A., 1941, II, 38.

Kinetics of reactions in the zinc-hydrogen irreversible cell. J. I. Jolley and H. V. Tartar (*Trans. Electrochem. Soc.*, 1940, 78, Preprint 10, 139—159).—Apparatus for the determination of the rate of reaction between Zn and acid, the metal being the anode of a Zn-H₂ irreversible cell, is described. The effect of the composition of the electrolyte, of rotation of the electrode, of temp., and of the resistance of the cell on the kinetics of the dissolution of Zn in various dil. acids has been investigated, and the similarity between the behaviour of the Zn-H₂ cell and of local galvanic couples is demonstrated. The rate of dissolution of Zn in acid is inversely \propto the resistance of the electrolyte, to the resistance of the external circuit between the anode and cathode, and to some function of the acid concn. J. W. C.

Electrolytic deposition of soft γ -manganese. E. Herrmann (*Ann. Physik*, 1940, [v], 37, 155—161).—Soft γ -Mn is deposited on a continuously wiped Al cathode of special design (c.d. 0.2 amp. per sq. cm.) in stirred aq. MnCl₂ and NH₄Cl ($p_H \sim 7$) (cf. Brunke, A., 1935, 19). The Pt anode, in saturated aq. NH₄Cl, is isolated in a porous cylinder wrapped in Cellophane; Cl₂ is led away from the anode surface through tubes. Brittleness of samples obtained previously is attributed to slight oxidation of the Mn solutions. The γ -Mn oxidises very rapidly on exposure to air unless passivated by dipping in aq. Na₂Cr₂O₇. A. J. E. W.

Reducibility of quadrivalent zirconium. A. W. Laubengayer and R. B. Eaton (*J. Amer. Chem. Soc.*, 1940, 62, 2704—2706).—From studies of the cathode processes involved in electrolysis of solutions of ZrCl₄ (0.169, 0.383, and 0.544M.) in HCl (6—8N.) only H₂ is produced and Zr⁺⁺⁺ is not reduced. Polarographic examination of solutions of ZrOCl₂ (0.01 and 0.001M.) at various p_H vals. (0.1M-KCl as indifferent electrolyte) indicates the existence of at least one, and sometimes two, reduction steps, the first due to H₂ discharge and the second at ~ 1.69 v. to reduction to Zr. The potential at which Zr is deposited varies with p_H . W. R. A.

Anodically oxidised coatings on aluminium.—See B., 1941, I, 37, 38.

Chemical action of electrical discharges. XX. Conditions for obtaining high energy yields in the synthesis of hydrogen cyanide by means of the electric arc. E. Briner and H. Hofer (*Helv. Chim. Acta*, 1940, 23, 1054—1062; cf. A., 1938, I, 150, 407).—The effects of pressure, relative concns., and the frequency of the discharge on the yield of HCN obtained by the action of an electric arc on mixtures of N₂ with CH₄, C₂H₆, *n*-C₄H₁₀, or *n*- or *iso*-C₅H₁₂ have been investigated. By using low pressures and an excess of N₂ the deposition of soot can be avoided without the addition of H₂. Under

optimum conditions of pressure and concn. the yields of HCN are 60, 80, 100, and 120 g. per kw.-hr. with CH₄, C₂H₆, C₄H₁₀, and C₅H₁₂, respectively. With C₅H₁₂-N₂ mixtures the [HCN] reaches 5%. J. W. S.

Free radicals in the process of pyrolysis and in the electrical discharge.—See A., 1941, II, 25.

Bromine-sensitised photodecomposition of ozone. R. Mungen and J. W. T. Spinks (*Canad. J. Res.*, 1940, 18, B, 363—371; cf. A., 1931, 1250).—The Br-sensitised photodecomp. of O₃ has been studied at 0—30° and atm. pressure, using light of λ 5460, 3650, and 2537 Å. The quantum yield is ~ 25 —30 for λ 5460 and 3650 Å., and is independent of [O₃]. For λ 2537 Å. the quantum yield is much smaller. The temp. coeff. for λ 5460 Å. is 1.01 for 10°. At -40°, in light but not in the dark, a Br oxide, probably Br₂O₃, is deposited on the walls, suggesting that the reaction involves the formation and decomp. of unstable Br oxides. A scheme is proposed, involving BrO₂ and BrO₃, and beginning with dissociation of Br₂ for the longer λ , and of O₃ for λ 2537 Å. F. J. G.

Photochemical reduction of ferric iron by oxalic acid. (Miss) G. Kornfeld (*J. Physical Chem.*, 1940, 44, 949).—In support of Livingston's conclusions (cf. A., 1940, I, 327) experiments which show that the reaction velocity \propto light intensity, and that the reaction proceeds to the end regardless of the presence of Fe⁺⁺, are mentioned. C. R. H.

Thermal decomposition of benzoyl peroxide. D. J. Brown (*J. Amer. Chem. Soc.*, 1940, 62, 2657—2659).—Calc. amounts of Bz₂O₂ (I) were diluted with C₆H₆ to a definite vol. and kept at 80°. At regular intervals samples were withdrawn, cooled rapidly to 20°, and undecomposed (I) was determined iodometrically. The initial velocities for the concn. range 0.025—0.80M-(I) have been measured. The decomp. velocity increases from zero to a max. and then satisfies the requirements of simultaneous occurrence of uni- and bi-mol. reactions. The decomp. is accelerated by light but is unaffected by surfaces. The products of the unimol. reaction are chiefly Ph₂ and CO₂, whilst the principal product of the bimol. reaction is BzOH. A mechanism is advanced. W. R. A.

Photochemical transformation of *trans*- into *cis*-*di-p*-toluoyl ethylene. W. H. Martin, H. D. Bett, R. G. Romans, and W. Tidridge (*Trans. Roy. Soc. Canada*, 1940, [iii], 34, III, 35—41).—The quantum yield for the isomerisation of *trans*-(I) to *cis*-*di-p*-toluoyl ethylene under the influence of light of λ 4047 Å. in COMe₂ at 35° is 0.45, suggesting that the equivalence law holds for the loosening of the double bond, and that there is a slightly greater chance of recombination to form (I), corresponding with its greater thermodynamical stability. F. J. G.

Heat of photobromination of phenylmethanes and cinnamic acid, and the influence of oxygen. J. L. Magee and F. Daniels (*J. Amer. Chem. Soc.*, 1940, 62, 2825—2833).—Photokinetics of Br substitution and addition at 25°, in the presence and absence of O₂, of CCl₄ solutions of CHPh₃, CH₂Ph₂, PhMe, and cinnamic acid (I) have been studied using calorimetric measurements and 4360 Å. At [Br] 0.002 mol. per l., light intensity 500 ergs per sec., and with almost complete removal of O₂, the quantum yields (ϕ) were 1000, 250, 50, and 35 mols. per quantum respectively; ϕ increases with [Br]. Heats of bromination in the absence of O₂ were 15, 12, 8, and 18 kg.-cal. per mol., respectively. All the brominations were chain reactions and all were inhibited by O₂, the inhibition being greatest for PhMe and (I) and least for CHPh₃. The larger evolution of heat in the presence of O₂ indicates that an oxidation process takes place during the inhibition reactions and is explained as a competing reaction between O₂ and the free radicals which propagate the chain. W. R. A.

Oxygen inhibition in photobromination of cinnamic acid. R. F. Brown and F. Daniels (*J. Amer. Chem. Soc.*, 1940, 62, 2820—2825).—Photobromination of cinnamic acid (I) at 25°, 35°, and 45° and of CHPh₃, stilbene, and CHPh₂CPh₃ at 35° in the presence and absence of O₂ has been studied. Approx. vals. of quantum yields (ϕ) are given. O₂ and traces of quinol greatly reduce ϕ , whilst H₂O vapour and BzO₂H have little effect. Although a large consumption of O₂ was observed during the bromination of (I) no peroxide formation could be detected. The effect of O₂ is attributed to competing reactions involving bromoperoxy cinnamic acid free radicals, whilst in the absence of O₂ chains are thought to be pro-

pagated by bromocinnamic acid free radicals. The temp. coeff. was ~ 1 in the absence of O_2 and >1 when O_2 was present. W. R. A.

Quantum yields of some dye-sensitized photo-oxidations. F. Hurd and R. Livingston (*J. Physical Chem.*, 1940, 44, 865—873).—Quantum yields of the photo-oxidation of I' , $S_2O_3^{2-}$, and allylthiocarbamide by several dyes have been determined. Similar experiments on the photo-oxidation of $H_2C_2O_4$ show this to be negligible. The data are compared with those of other investigators. C. R. H.

Quantum yield as function of wave-length for inactivation of urease.—See A., 1940, III, 931.

IX.—METHODS OF PREPARATION.

Preparation of ortho-deuterium. L. Farkas and L. Sandler (*J. Amer. Chem. Soc.*, 1940, 62, 2877—2878).—The $p \rightarrow o$ conversion of D_2 has been carried out by adiabatic desorption of H_2 from charcoal pre-cooled by solid air in an apparatus which is described. W. R. A.

Preparation of "absolute water" with the "Allassions." R. Loosjes and W. R. Domingo (*Chem. Weekblad*, 1939, 36, 835—836).— H_2O equal to distilled H_2O in quality can be obtained by treating tap- H_2O with ion-exchange agents (Allassion-C and -A) and finally with $Na_2Al_2O_4$ to remove SiO_2 . The cost of chemicals for regenerating the adsorbents is a fraction of that for distillation. (Cf. A., 1938, I, 153.) S. C.

Oxygen exchange between water and inorganic oxy-anions. G. A. Mills (*J. Amer. Chem. Soc.*, 1940, 62, 2833—2838).—A known wt. of inorg. salt was dissolved in a definite amount of H_2O having ^{18}O fraction of 86×10^{-5} (ordinary H_2O has ^{18}O fraction of 200×10^{-5}) and maintained at const. temp. for a certain time, after which the water was distilled off in a vacuum and analysed for ^{18}O . Pyrex glass and a strongly alkaline solution gave no exchange at 110° . At 19.3° there was complete exchange between CrO_3 and H_2O in 1.5 hr. With Na_2CrO_4 and H_2O at 19.3° complete exchange did not occur until 96 hr. but at 70° and 110° the time was 2 hr. and 3 hr., respectively. $Na_2CrO_4-H_2O-NaOH$ gave no exchange at 19.3° , partial exchange at 70° after 2 hr., and approx. complete exchange at 110° after 3 hr. $KHSO_4-H_2O$ exhibited partial exchange at 100° , whereas no exchange could be effected with $K_2SO_4-H_2O$ or with Na amalgam- H_2O . On the other hand, $Na_2S_2O_5-H_2O$ showed partial exchange after 1 hr. at 19.3° . $K_2S_2O_8-H_2O$ showed no exchange at 19.3° after 2 hr. but partial exchange after 2 hr. and complete exchange after 24 hr. at 100° ; when NaOH was added no exchange, at 100° for 4 hr., occurred. $KMnO_4$ and H_2O at 100° exchange ^{18}O partly after 1 hr. and completely after 24 hr. The exchange may take place in three ways: (i) direct interchange of O atoms, (ii) addition and subsequent removal of H_2O or OH' to the anion with possible exchange, and (iii) formation of undissociated acid by hydrolysis, followed by reversible anhydride formation. The last accounts satisfactorily for experimental data. In all cases the rate of O exchange is related to the acid strength of the corresponding acid. W. R. A.

Spontaneous decomposition of sodium hypochlorite. J. M. A. y Infiguez (*Rev. univ. Zaragoza*, 1936, 65 pp.).—In alkaline solutions NaOCl decomposes little in the absence of O_2 . In strongly alkaline solutions mutual oxidation of OCl' ions occurs. In slightly alkaline solutions OCl' is oxidised by HOCl. This reaction is catalysed by Cl'. Ch. Abs. (e)

Interaction between potassium metaperiodate and the soluble salts of metals of alkaline earths. R. K. Bahl and M. Lal (*J. Indian Chem. Soc.*, 1940, 17, 395—396).—When a hot solution of KIO_4 is added to a boiling solution of $CaCl_2$, $SrCl_2$, or $BaCl_2$, $Ca_2I_2O_8 \cdot 8H_2O$, $Sr_2I_2O_8 \cdot 8H_2O$, and $Ba_2I_2O_8 \cdot 4H_2O$, respectively, are pptd. C. R. H.

Production of beryllium compounds free from iron.—See B., 1941, I, 65.

Electron diffraction study of the surface of magnesium attacked by an aqueous chloride solution. S. Yamaguchi (*Nature*, 1940, 146, 654).—In the first stage of corrosion by Cl' the Mg is covered first by a black and then by a white porous substance. Electron diffraction shows that both substances consist of crystals of $Mg(OH)_2$ and MgO . The

surface film that protects Mg from the action of H_2O consists of a mixture of cryst. $Mg(OH)_2$ and MgO . Cl' thus catalyses the reaction between Mg and H_2O . L. S. T.

Action of chlorine on the hydroxides of alkaline earths in presence of iodine. II. R. K. Bahl and S. Singh (*J. Indian Chem. Soc.*, 1940, 17, 397—399).—When Cl_2 is passed through hot solutions of $Ba(OH)_2$ or $Sr(OH)_2$ or suspensions of $Ca(OH)_2$ containing dissolved I, $Ba(IO_3)_2 \cdot H_2O$, $Sr(IO_3)_2 \cdot H_2O$, and $Ca(IO_3)_2 \cdot 6H_2O$, respectively, are pptd., and I is liberated. Periodate is not formed. C. R. H.

Effect of carbonate-ion concentration in water softening.—See B., 1941, III, 26.

Illustrations of reactions between solids. H. S. van Klooster (*J. Chem. Educ.*, 1940, 17, 361—363).—Reactions in mixtures of PbS and $CdSO_4$, K_2S and $CdSO_4$, $PbCl_2$ and KI, $HgCl_2$ and KI, $CoSO_4$ and NaCl, BaS and $ZnSO_4$, and BaS and $CdSO_4$ are discussed. L. S. T.

Dissolution and precipitation of lead and zinc sulphides in sodium sulphide solutions. F. G. Smith (*Econ. Geol.*, 1940, 35, 646—658).—Amorphous ZnS and PbS dissolve to a limited extent in aq. Na_2S_{n+1} and NaSH on heating at $415-425^\circ$ for 2—3 hr. in a C-lined steel bomb. As the solutions cool ($18-20^\circ$ hr.), sphalerite (I) crystallises before galena (II). (I) then redissolves partly, and is deposited later as amorphous ZnS, small crystals of (I), or as wurtzite (III). (II) redissolves to a smaller extent, and is deposited later as microcryst. (II). The redissolution of (I) and (II) is due probably to colloidal dispersion, and the higher is the [S] in the solution the less important are the later colloidal effects. The higher is $[NaHS]/[Na_2S_{n+1}]$, the greater is the tendency for (III) rather than (I) to form from the deposition of ZnS from the colloidal state. Solutions of Na_2S_{n+1} and/or NaHS may be the type of solution active in the transportation of (I) and (II) in nature. L. S. T.

Bleaching of lead pigments darkened by exposure to hydrogen sulphide.—See B., 1941, II, 19.

Effect on lead arsenate of certain salts which may be present in soil and spray waters.—See B., 1941, III, 6.

Nitroxyl perchlorate. W. E. Gordon and J. W. T. Spinks (*Canad. J. Res.*, 1940, 18, B, 358—362).—Nitroxyl perchlorate, $NCIO_4$, is obtained by the action of small amounts of ClO_2 on air charged with N oxides and O_2 by an ozoniser. It is a white cryst. substance having a v.p. < 0.05 mm. at room temp.; it decomposes at 120° . It is sol. in $POCl_3$, insol. in CCl_4 , and reacts violently with most org. liquids. It dissolves in H_2O , affording HNO_3 and $HClO_4$, and it reacts with I on warming, affording I_2O_5 and (probably) ICl. $NCIO_4$ is to be regarded as a mixed anhydride of HNO_3 and $HClO_4$. It probably results from direct union of NO_2 and ClO_2 , these being formed by the action of O_3 on NO_2 and ClO_2 , respectively. F. J. G.

Sulphur iodides. III. Sulphur di-iodide. M. R. A. N. Rao (*J. Mysore Univ.*, 1940, I, 75—82; cf. A., 1940, I, 296).—Treatment of a dil. solution of SCl_2 (in dry CCl_4) with dry KI yields S di-iodide, which is brown in dil. solution. In light it decomposes rapidly into S and I. It also decomposes into S and I on contact with H_2O , but with NaOH in the presence of $Cd(OH)_2$ considerable amounts of CdS , Na_2SO_3 , $Na_2S_2O_3$, and Na_2SO_4 are also formed, the amount of free S liberated being the less the greater is the [NaOH]. Investigation of the hydrolysis of S_2I_2 in the presence of I, added to the aq. NaOH or to the S_2I_2 in CCl_4 before mixing, indicates that SI_2 may also be formed when I is added to S_2I_2 in CCl_4 . J. W. S.

Preparation of chemically pure CrO_3 . N. D. Birjukov (*J. Gen. Chem. Russ.*, 1940, 10, 942—944).— CrO_3 decomposes in hot aq. solution as follows: $2CrO_3 \rightarrow Cr_2O_3 + 3O$; $Cr_2O_3 + 3H_2CrO_4 \rightarrow Cr_2(CrO_4)_3 + 3H_2O$; $Cr_2(CrO_4)_3 \rightarrow Cr_2O_3 + 3CrO_3$. For this reason CrO_3 cannot be obtained chemically pure by recrystallisation. R. T.

Highly substituted sodium salts of phosphomolybdic acid. E. A. Nikitina (*J. Gen. Chem. Russ.*, 1940, 10, 997—1006).—Salts of the composition $nNa_2O \cdot P_2O_5 \cdot 24MoO_3$ ($n = 4-11$) have been prepared by adding the theoretical amount of NaOH to $Na_2[PO_4 \cdot Mo_{12}O_{36}(OH)]$. $11Na_2O \cdot P_2O_5 \cdot 24MoO_3$ and aq. NaOH yield Na_2HPO_4 and $5Na_2O \cdot 12MoO_3$. The structure of 24-phosphomolybdic acid is discussed in the light of these findings. R. T.

Photochemical preparation of tungsten by cold-reduction of tungstic acid, WO_3 .—See B., 1941, I, 36.

X.—ANALYSIS.

Quantitative analysis and the theory of measurement. F. H. Hurley (*J. Chem. Educ.*, 1940, 17, 334—336).—A discussion. L. S. T.

Systematic separation of anions. E. Umbria (*Keem. Teated*, 1935, 2, 79—87).—A scheme for the separation of anions is given. CH. ABS. (e)

Electrochemical determination of iodine. M. Tovbin and M. Feldman (*Bull. Sci. Univ. Kiev*, 1939, No. 4, 185—195).—Small concns. of I (2—10 mg. per l.) are determined by an electrochemical method, depending on the depolarising effect of I during electrolysis with a voltage < that of the decomp. potential. R. T.

Sodium furoate as preservative [of thiosulphate and starch solutions]. A. M. Platow (*Chemist Analyst*, 1939, 28, 30—31; *Int. Sugar J.*, 1940, 42, 69).— $\text{Na}_2\text{S}_2\text{O}_3$ to which 0.1% of Na furoate (I) had been added preserved its normality for 3 months. Furoic acid as well as (I) (0.1%) preserved starch solution indefinitely without settling occurring. J. P. O.

Determination of phosphorus in stainless steels by the rapid "analog" method.—See B., 1941, I, 33.

Rapid determination of arsenic by distillation.—See B., 1941, I, 36.

Determination of small quantities of carbon dioxide in air by absorption of infra-red radiation. H. Dingle and A. W. Pryce (*Proc. Roy. Soc.*, 1940, B, 129, 468—474).—Determination of up to ~0.2% of CO_2 in air (dried by P_2O_5) is based on the strong absorption band of CO_2 at $\sim 4.3 \mu$. The radiation from a Meker burner passes through a stainless-steel tube containing the air and the transmitted radiation is measured by a thermopile; a similarly fitted tube, symmetrically placed on the other side of the burner, forms a balancing control for the galvanometer circuit and the deflexion is calibrated by observations with air of known CO_2 content in one of the tubes. F. O. H.

Micro-titrimetric determination of carbon dioxide in carbonates. A. F. Colson (*Analyst*, 1940, 65, 638—643).—A micro-apparatus is described, with reference to a sketch, for determining a few mg. of CO_2 by absorption in NaOH and BaCl_2 solution followed by neutralisation to phenolphthalein and acidimetric titration of the BaCO_3 ppt. Possible sources of error and means of avoiding them are discussed. A. R. P.

Microchemical determination of silver for toxicological analysis. S. Wehrli (*Helv. Chim. Acta*, 1940, 23, 1197—1200).—The org. material is treated with H_2SO_4 and fuming HNO_3 , and, after removal of the HNO_3 and most of the H_2SO_4 by heating, the solution is diluted, boiled, and filtered. The filtrate (~20 c.c.) is treated with CuSO_4 (10 mg.) and saturated with H_2S . The ppt. is separated, dissolved in fuming HNO_3 , and after dilution is again treated with H_2S . This process is repeated until a clear blue solution is obtained. This solution is then evaporated with H_2SO_4 , diluted, and electrolysed in a divided cell, using a Au cathode and 30% H_2SO_4 as anolyte. After prolonged electrolysis at 1.2 v. the Ag is completely deposited on the Au, and can be dissolved in HNO_3 . The opalescence obtained on addition of a trace of dil. HCl is observed. The Ag can be re-deposited by electrolysis using a Au cathode and Pt anode after addition of excess of NH_3 . J. W. S.

Electrochemical methods in microchemistry. E. B. Ashcraft (*Trans. Electrochem. Soc.*, 1940, 78, Preprint 9, 127—137).—A review of progress in the electrometric detection of small quantities of Ag, Cu, Zn, As, and other metals, and in the electrolytic determination of Cu, Hg, Ag, Ni, Sn, Zn, etc., and of several acid radicals. J. W. C.

Assay of zinc stearate ointment.—See B., 1941, III, 21.

Quinaldinic acid as a reagent for the separation of copper and cadmium. A. J. Lindsay and R. J. Shennan (*Analyst*, 1940, 65, 636—638).—For complete pptn. of Cu by Na quinaldinate (I) in H_2SO_4 solutions of p_H 1.22 a threefold excess of (I) is necessary but complete pptn. is obtained in AcOH solutions of p_H 1.5—6.86. In the presence of Cd the ppt. of Cu compound is always contaminated with Cd under all conditions which ensure complete pptn. of the Cu. Ray and Bose's method (A., 1934, 270) is therefore untrustworthy. A. R. P.

Assay of mercuric chloride.—See B., 1941, I, 18.

Determination of mercuramine chloride in ointments.—See B., 1941, III, 20.

Application of base-exchange materials in analytical chemistry. IV. Determination of iron and aluminium in presence of phosphoric acid. O. Samuelson (*Svensk Kem. Tidskr.*, 1940, 52, 241—247; cf. A., 1940, I, 444).—Fe and Al are removed from the PO_4^{3-} -containing solution by percolating it through a sulphonated organolith, which is washed free from PO_4^{3-} with H_2O , and the metal ions then eluted with dil. HCl and determined in the usual way. Metal-phosphate complexes are decomposed during the percolation and do not cause errors, but PO_3' and $\text{P}_2\text{O}_7^{4-}$ should be converted into PO_4^{3-} beforehand. M. H. M. A.

Cyanometric determination of cobalt and nickel. W. J. Agnew (*Analyst*, 1940, 65, 643—644).—Evans' method (A., 1937, I, 377) has been modified as follows: the neutral Co + Ni solution containing ≥ 0.04 g. of metal is diluted to 150 ml., treated with 10 ml. of 1:1 HNO_3 and an excess of standard KCN solution, shaken for 4 min., treated with 20 ml. of 1:1 aq. NH_3 and 10 ml. of 4% aq. KI, and titrated as usual with AgNO_3 . The Ni consumes 4KCN and the Co 6KCN. In a second portion of the original solution the Ni is determined by the glyoxime method after treating the solution as above and destroying the excess of KCN by boiling with ammoniacal H_2O_2 which oxidises the Co to $\text{Co}(\text{CN})_6^{3-}$ and destroys the $\text{Ni}(\text{CN})_4^{2-}$. A. R. P.

Rapid determination of tungsten in tungsten steels.—See B., 1941, I, 33.

XI.—APPARATUS ETC.

Thermostatic control. C. Butt (*Science*, 1940, 92, 339—340).—A circuit operated by a.c. is described. L. S. T.

Air jacket for f.p. apparatus. H. G. Cassidy (*J. Chem. Educ.*, 1940, 17, 397—398).—Glass tubing closed at one end by a rubber bung forms a strong jacket. L. S. T.

Barrier-layer resistance of selenium photo-cells. A. E. Sandström (*Phil. Mag.*, 1940, [vii], 30, 428—429; cf. A., 1940, I, 83).—"Tiring" of photo-elements has now been observed. Increased resistance produced by electric shock has been confirmed. When an illuminated element is restored to darkness the increase in resistance is almost immediate. O. D. S.

Emission spectrum analysis as a routine quantitative method. Application to the analysis of pure aluminium. A. von Zeerleder and F. Rohner (*Helv. Chim. Acta*, 1940, 23, 1287—1297).—The apparatus used in the routine determination of Si, Fe, and Cu in Al by emission spectrum analysis is described, and the advantages of this method over chemical methods are discussed. J. W. S.

Colour control.—See B., 1941, I, 2.

Cathodic rectification of current in zero arm of Nernst bridge. A. G. Sarkisov (*Kolloid. Shurn.*, 1939, 5, 389—392).—The use of a valve-rectifier in the Nernst bridge for measuring dielectric const. is described. R. C.

Determination of p_H with the thymoquinhydrone electrode. H. J. C. Tendeloo, J. S. Buy, and J. A. Huyskes (*Landbouwk. Tijds.*, 1938, 50, 742—746; *Chem. Zentr.*, 1938, ii, 3576).—Thymoquinhydrone (I), a 1:1 mol. compound of thymoquinone and -quinol, may be used at $p_H \geq 10.5$. If the e.m.f. of the (I) cell with a saturated HgCl electrode is E mv., $p_H = (359 - E)/57.7$. At $E = 0$, $p_H = 6.22$. A. J. E. W.

Improved [electrical] conductivity apparatus. W. S. McGuire (*J. Chem. Educ.*, 1940, 17, 381—382). L. S. T.

Vacuum tube oscillator for measuring the conductance of electrolytes. D. E. Hull (*J. Chem. Educ.*, 1940, 17, 329). L. S. T.

Apparatus for measuring the dielectric constant of non-conducting liquids. B. E. Hudson and M. E. Hobbs (*J. Chem. Educ.*, 1940, 17, 366—370).—The method is based on the heterodyne beat principle. Wiring diagrams are reproduced. Performance is illustrated by determinations of μ for PhNO_2 in C_6H_6 and of ϵ for mixtures of Et_2O and CHCl_3 . L. S. T.

Projection Wilson chamber. M. B. Holm (*Fys. Tidskr.*, 1938, 36, 63—67; *Chem. Zentr.*, 1938, ii, 3366—3367).—A radial expansion chamber (Wilson and Wilson, A., 1935,

599) containing a mixture of EtOH and H₂O vapours (1 : 1) is arranged with an arc lamp and condenser to give α -ray track images ~ 2 m. in length. A. J. E. W.

High-temperature positive-column discharge tubes. R. F. Barrow (*Proc. Physical Soc.*, 1941, 53, 40–43).—The construction and operation of two tubes for investigating the emission spectra of refractory materials are described. The temp. necessary for developing a convenient v.p. of the material is attained by degradation of part of the energy of the positive column of the discharge which is constricted, in one case, in the narrow central part of an all-SiO₂ tube, and, in the other, by a small axial hole through a sintered Al₂O₃ cylinder, supported centrally in a SiO₂ envelope tube. N. M. B.

Improved pole-piece construction of the objective lens of a magnetic electron microscope. A. Prebus (*Canad. J. Res.*, 1940, 18, A, 175–177; cf. A., 1939, I, 433).—The use of a thin-walled Fe tube as spacer facilitates construction and allows a higher degree of axial symmetry. F. J. G.

Integrating circuit for vapour-type Geiger-Müller counters. L. F. Curtiss (*J. Res. Nat. Bur. Stand.*, 1940, 25, 369–377).—A circuit for integrating the pulses from tube counters filled with EtOH vapour and A, and recording them as a steady deflexion on a milliammeter, is described. The pulses are amplified and levelled with a resistance-capacity coupled amplifier, and are then rectified and fed into a condenser with resistance leak. A valve voltmeter measures the voltage of this condenser, which \propto the counting rate. J. W. S.

Apparatus for study of the physics of the atomic nucleus. R. Schmidt (*Tech. mod.*, 1938, 30, 585–592; *Chem. Zentr.*, 1938, ii, 3675).—A description of apparatus for the production and use of high voltages in nuclear physics. A. J. E. W.

American apparatus, instruments, and instrumentation. R. M. Müller (*Ind. Eng. Chem. [Anal.]*, 1940, 12, 571–630).—A review in which developments and modern trends in the following are illustrated: linear and displacement measurements; weighing; time measurements; temp. production, control, and measurement; high vac. and measurement and control of gases; electrical and electronic instruments; optical instruments; glassware; automatic controllers and recorders; instrumental methods of analysis; microchemistry; and general laboratory appliances. L. S. T.

Producing air-vapour mixtures in gas or fume chambers. L. Silverman (*J. Sci. Instr.*, 1940, 11, 346).—Liquid is introduced into the chamber from a calibrated syringe provided with an electrically heated jet. O. D. S.

Measurement of static and dynamic foams in characteristic units. G. L. Clark and S. Ross (*Ind. Eng. Chem.*, 1940, 32, 1594–1598).—A static foam meter is described, in which the rate of accumulation of liquid resulting from the collapse of a previously produced foam is measured. The "foaminess," Σ , derived from the known exponential rate of decrease in the no. of bubbles, is expressed in sec. by the formula $\Sigma = t/2.3 \log [100/(100 - V)]$, where V is the vol. of liquid collected in t sec. from a foam prepared under standard conditions. With ovalbumin dynamic measurements give higher vals. of Σ for CO₂ than for air, whilst the converse is true of static measurements. These foams do not follow a logarithmic law of subsidence, whereas beer foams do so over a considerable range of their lifetime. There is evidence of a reaction between CO₂ and ovalbumin, a solid scum being produced which is not observed when the foam is made with air. F. L. U.

Micro-pyknometer. G. Okamoto and M. Shindo (*J. Chem. Soc. Japan*, 1936, 57, 609–613).—A discussion of the sensitivity of the float for determining the d of D₂O. CH. ABS. (e)

Mol. wt. by isothermic distillation. J. B. Niederl and A. M. Levy (*Science*, 1940, 92, 225–226).—Barger's method (*J.C.S.*, 1904, 85, 286) is modified so that mixing of the two solutions is prevented by using two capillaries, one for the unknown sample and one for the standard. Differentiation between ± 0.01 molarities is possible. L. S. T.

Powder method for measurement of chemical durability of glass.—See B., 1941, I, 23.

Generation of hydrogen sulphide. A. H. Prezioso (*J. Chem. Educ.*, 1940, 17, 399).—Apparatus for generating H₂S (FeS and HCl) and storing it over H₂O is described and illustrated. I. S. T.

Wash bottle. R. Woodruff (*J. Chem. Educ.*, 1940, 17, 323).—A wash bottle which enables the amount of wash liquid to be measured and controlled accurately, and is operated by a rubber bulb, is described and illustrated. L. S. T.

Air-driven ultracentrifuge. F. R. Eirich and E. K. Rideal (*Nature*, 1940, 146, 541–542, 551–552).—Construction and operation of an experimental model are outlined. Performance is illustrated by data recorded for ovalbumin, cytochrome C, a globulin arachin from *Arachis hypogaea*, and carbonic anhydrase. The globulin appears to contain five different groups of mol. wts. dependent on the nature of the salt used to effect dissolution. L. S. T.

Drying apparatus for flasks. F. L. James (*J. Chem. Educ.*, 1940, 17, 400).—An ordinary hair dryer fitted with a brass reducer and Cu nozzle serves to introduce air into the heated flask. L. S. T.

Apparatus for rapid determination of arsenic in presence of antimony. V. Biskupski (*Bull. Soc. Chim. Yougoslav.*, 1939, 10, 75–80).—Distillation is conducted in a stream of HCl at 70–100°, when AsCl₃, but not SbCl₃, distils over. R. T.

Determination of mol. wt. at low pressures by means of V. Meyer's method. D. Milosavljević and M. Jovanović (*Bull. Soc. Chim. Yougoslav.*, 1939, 10, 57–62).—Meyer's method is adapted for low pressures. R. T.

Safety valve to prevent return of water in water pumps. S. Ristić (*Bull. Soc. Chim. Yougoslav.*, 1939, 10, 85–86).—Minor modifications of Fournier's device (A., 1938, I, 278) are proposed. R. T.

Use of anhydrite as a desiccating agent. H. Hawley (*Analyst*, 1940, 65, 644–645).—Anhydrite prepared by dehydrating white gypsum at 230–250° absorbs up to 5% of its wt. of H₂O from the air rapidly and evenly and is a better desiccating agent than CaCl₂ for drying gases or use in a desiccator; it can be regenerated many times. It effectively removes H₂O from EtOH, 100 g. being required to bring 100 c.c. from 98% to 99.8% EtOH. A. R. P.

Modified lecture experiment. W. J. Conway (*J. Chem. Educ.*, 1940, 17, 398).—Directions for demonstrating the law of mass action by means of the liberation of I from KIO₃ and H₂SO₄ are given. The addition of EtOH stabilises the solution of H₂SO₄. L. S. T.

[Electrical] conductivity tests for reactions that go to an end. E. L. Gunn (*J. Chem. Educ.*, 1940, 17, 385–386).—Apparatus for demonstrating the completeness of various ionic reactions is described. L. S. T.

Earliest history of capillary chemistry. I. Traube (*J. Chem. Educ.*, 1940, 17, 324–329).—A review. L. S. T.

XIII.—GEOCHEMISTRY.

Charged particles in the dust of the atmosphere at Vesuvius. F. Signore (*Ann. Osservator. Vesuviano*, 1935, [iv], 3, 17–44).—The high val. obtained for the charged particles in the air is partly due to the high radioactivity of the Vesuvian lavas. CH. ABS. (e)

Analysis and study of hot spring-water in Foochow. T. H. Wang and Y. T. Lin (*Amer. J. Sci.*, 1940, 238, 799–804).—Ten analyses of H₂O from hot springs and hot H₂O wells are recorded and discussed. The H₂O is of volcanic origin, descending surface H₂O being heated by contact with hot rock masses. One fissure spring has a high F content, and evolves gas, probably N₂. L. S. T.

Iron dissolved in the lake waters of Japan. II. S. Yoshimura (*Japan. J. Geol.*, 1936, 13, 39–56; cf. *ibid.*, 1931, 9, 61).—Data for the surface waters of 150 Japanese lakes are given. CH. ABS. (e)

Bartlett meteorite, Bell Co., Texas. F. M. Bullard (*Amer. Min.*, 1940, 25, 497–500).—The meteorite is a medium octahedrite composed of kamacite with some taenite, plessite, schreibersite, troilite, and possibly lawrencite. The chemical analysis [F. A. Gonyer] is Fe 90.41, Ni 8.88, Co 0.47, P 0.22, Cu none, Cl trace, S none, Mn none, total 99.98%. The spectrographic analysis [H. A. Wilhelm] shows the presence of Fe, Ni, Co, with traces of Ge, Cu, and Si. L. S. T.

Quartz crystal with base from Nil St. Vincent. H. Buttgenbach (*Ann. Soc. géol. Belg., Bull.*, 1938, 61, 325–326; *Chem.*

Zentr., 1938, ii, 3524).—An occurrence of the very rare base, (0001), is reported. A. J. E. W.

Composition and properties of shore and dune sands. W. H. Barrett (*Geol. Mag.*, 1940, 77, 383—394).—The significance of minor variations in composition and properties of sand samples collected from the neighbourhood of Perranporth, Cornwall, has been investigated. Mechanical and chemical compositions, heavy mineral contents, and measurements of the degree of rounding are recorded and discussed. L. S. T.

Thorium-uranium ratio in rocks and in the sea. H. Pettersson [with E. Focyn, B. Karlik, and E. Rona] (*Anz. Akad. Wiss. Wien, math.-nat. Kl.*, 1937, 127—128; *Chem. Zentr.*, 1938, ii, 3382).—Skagerrak sea-H₂O contains 10⁻⁶ g. of Th and 1.5—2.0 × 10⁻⁶ g. of U per l.; the Th:U ratio is thus probably <0.5. The deficit of Th is due to co-pptn. in sediments, probably with Fe(OH)₃; simultaneous pptn. of Io may be the cause of a reduced Ra:U ratio in the H₂O, although pptn. of RaCO₃ with CaCO₃ in living organisms is also possible. A. J. E. W.

Lattice constants of cerussite. G. A. Lindsay and H. C. Hoyt (*Z. Krist.*, 1938, 100, 360—362; cf. Colby, A., 1933, 215).—A precision X-ray determination, by the Bragg method, of natural face spacings of a specimen from Tsumeb gives the cell elements: *a* 5.1726, *b* 8.4800, *c* 6.1302 Å. I. McA.

Origin of the nelsonite dykes of Amherst Co., Virginia. C. H. Moore, jun. (*Econ. Geol.*, 1940, 35, 629—645).—Rock types are described, and the origin of the nelsonite dykes is discussed. Nelsonite dykes, consisting mainly of ilmenite and apatite, are related genetically to a younger hypersthene granodiorite that invaded the host rock of Lovington gneiss. L. S. T.

Microscopical features of ore from the Sunshine Mine, Idaho. R. J. Anderson (*Econ. Geol.*, 1940, 35, 659—667).—Tetrahedrite (I) is the Ag-bearing mineral, but as polished surfaces show no Ag minerals in it the Ag is present probably as an isomorphous constituent. Pyrite was the earliest sulphide, followed by arsenopyrite, (I), galena (II), and chalcopyrite. Where (II) is in contact with (I) the development of bournonite is common. Siderite and quartz are the important gangue minerals. L. S. T.

Nature of the ore-forming fluid. E. Ingerson and G. W. Morey (*Econ. Geol.*, 1940, 35, 772—785).—A discussion of Gratton's views (cf. A., 1940, I, 379). L. S. T.

Zinc and lead deposits of Shawangunk Mountain, New York. A. I. Ingham (*Econ. Geol.*, 1940, 35, 751—760).—Geology, mode of occurrence, and mineralogy are described. The ores were deposited probably by solutions of magmatic origin. L. S. T.

Structure and mineral zoning of the Pailaviri Section, Potosi, Bolivia. D. L. Evans (*Econ. Geol.*, 1940, 35, 737—750).—Mineralisation has been dependent on structure and zoning, and not on favourable or unfavourable rock types. Three periods of mineralisation are indicated. L. S. T.

Paragenesis in the Hollinger [Porcupine District, Ontario] veins. M. R. Keys (*Econ. Geol.*, 1940, 35, 611—628).—The minerals of the Au deposits are described, and their paragenesis is discussed. Most of the Au occurs in a quartz-ankerite-pyrite type of ore body, and was introduced later than the major period of quartz mineralisation. In the veins, the Au appears to be related genetically to a pale green sericite; in the wall rocks, it is associated with, but is probably later than, pyrite. L. S. T.

Albite and gold. D. Gallagher (*Econ. Geol.*, 1940, 35, 698—736).—A literature review shows that numerous Au deposits from many parts of the world are related genetically to albite-rich igneous rocks. These deposits contain little Ag, and the sulphides are simple and not abundant, whereas Au deposits related genetically to K-rich rocks are argentiferous, polymetallic, or contain abundant sulphides. The Au deposits cannot be explained by a one-magma theory of petrogenesis; the granitic and trondhjemitic rock suites with their respective pegmatites and Au deposits are derived from two distinct magma types. L. S. T.

Alaskitic gold vein of the Kinsei Mine, Korea. T. Kato (*Japan. J. Geol.*, 1936, 13, 103—105).—The deposit is described. The Au content in some parts is 50—80 g. per ton; a common figure is 10 g. per ton. CH. Abs. (e)

Genetic relations of gold deposits and igneous rocks in the Canadian shield. E. S. Moore (*Econ. Geol.*, 1940, 35, 127—139).—An address in which periods of Au deposition, magmatic sequences, and the rôle of lamprophyres and other basic rocks in ore deposition are discussed. L. S. T.

Bornite-klaprotholite relations at Concepcion del Oro, Mexico. P. Krieger (*Econ. Geol.*, 1940, 35, 687—697).—The occurrence of klaprotholite (I) in the Cu ore of this district, and its relation to bornite (II), are described. (I) and (II) were probably deposited simultaneously as products of unmixing from a solid solution. L. S. T.

Cordierite-anthophyllite rocks associated with spinel-hypersthene from Toodyay, W. Australia. R. T. Prider (*Geol. Mag.*, 1940, 77, 364—382).—The petrography and petrogenesis are described, and 9 chemical analyses are recorded. L. S. T.

Contact metamorphism by a Tertiary dyke at Waterfoot, Co. Antrim. D. L. Reynolds (*Geol. Mag.*, 1940, 77, 461—469).—Felsitic material, often spherulitic in habit, and resembling felsite resulting from the rapid cooling of acid igneous material, has developed in Triassic pebble beds at their contact with a Tertiary dyke of olivine-dolerite, as a result of potash metasomatism at a temp. high enough for tridymite to form. Chemical analyses [W. H. Herdsman] of two sandstones are recorded. L. S. T.

Geology of Basutoland. G. M. Stockley (*Geol. Mag.*, 1940, 77, 444—460).—The geological succession and structure, the stratigraphy of the Stormberg sediments, the volcanicity of the Drakensberg beds, and the petrography of the Drakensberg lavas and dolerites are discussed. Chemical analyses of a basalt from the Orange River and one from the Malibamatso River are included. L. S. T.

Magnetite in sulphide ores. G. M. Schwartz and A. C. Ronbeck (*Econ. Geol.*, 1940, 35, 585—610).—A review of the literature indicates that magnetite (I) occurs in numerous sulphide deposits as an epigenetic mineral. Tabulation of 130 deposits or districts in which (I) occurs shows that the common sulphides, in order of the no. of occurrences, are: chalcopyrite, pyrite (II), pyrrhotite, sphalerite, galena, arsenopyrite, bornite, and chalcocite. Lesser sulphides such as molybdenite, pentlandite, marcasite, cubanite, enargite, tetrahedrite, and covellite occur less commonly. Hämatite is a common associate of (I) in these deposits. (I) with sulphides occurs in deposits of magmatic, pyrometamorphic, and hypothermal origin; it is practically absent in other types of deposits. Normally, (I) is the first metallic mineral to form, indicating that, in general, it forms only at high temp. In a few deposits (I) is preceded by (II), or, less commonly, by other sulphides. Once formed, (I) is stable; it shows only moderate evidence of replacement by later minerals. L. S. T.

Sphalerite and galena in sedimentary rocks in Ohio. K. Ver Steeg (*Science*, 1940, 92, 259).—Occurrences of these two minerals in association are noted. L. S. T.

New source for agate artifacts in central New Mexico. F. T. McCann (*Science*, 1940, 92, 259).—Some of the agate artifacts in this area are derived from rock *in situ*, and not from river gravels. Cerro Colorado is such a source. L. S. T.

Geochemistry of quicksilver mineralisation. I, II. R. M. Dreyer (*Econ. Geol.*, 1940, 35, 17—48, 140—157).—I. Chemical and physical factors that result in the formation of a typical Hg ore, containing cinnabar and possibly Hg and meta-cinnabar, and the relation of the common Hg and gangue minerals to the mineralising solutions are discussed.

II. Petrographic aspects of the geochemistry of Hg mineralisation are discussed. These include the relation of cinnabar deposition to characteristic types of wall rock alteration, the relation of FeS₂ to HgS mineralisation, and the mode of access of the mineralising solutions into the country rocks. The marked syngensis of cinnabar with SiO₂ is emphasised. L. S. T.

Geochemistry of quicksilver mineralisation. J. J. Fahey, M. Fleischer, and C. P. Ross (*Econ. Geol.*, 1940, 35, 465—470).—A criticism of some of Dreyer's conclusions (preceding abstract). L. S. T.

Temperature and depth in hypogene ore deposition. E. Y. Dougherty (*Econ. Geol.*, 1940, 35, 188—191).—A discussion. L. S. T.

Pegmatites of the Spruce Pine district, N. Carolina. C. S. Maurice (*Econ. Geol.*, 1940, 35, 158—187; cf. A., 1940, I, 303). L. S. T.

Tridymite. C. Durrell (*Amer. Min.*, 1940, 25, 501—502).—Tridymite from Plumas Co., California, has α 1.478, β 1.479, γ 1.481 (all ± 0.001). L. S. T.

Relation between colloidal character of certain marls and their behaviour in borings and in tectonics. M. Didier and J. Lacoste (*Compt. rend. Soc. géol. France*, 1938, 137—139; *Chem. Zentr.*, 1938, ii, 3383).—Cretaceous marl from Morocco absorbs twice to three times as much H_2O as other marls, and gives a viscous colloidal solution (d 1.2—1.3) which is readily flocculated in sea- H_2O . The marl contains clay with 5.72% of very finely-divided dolomite. The properties given explain its unusual plastic character. A. J. E. W.

Effect of volume constancy of reacting solid components on magmas. P. Michot (*Ann. Soc. géol. Belg.*, *Bull.*, 1938, 61, 337—339; *Chem. Zentr.*, 1938, ii, 3383).—The composition of a magma after reaction with adjacent rocks differs according as the reactants have const. or variable vol. A. J. E. W.

Decomposition of rocks and ceramic materials with a small amount of sodium carbonate. J. I. Hoffman (*J. Res. Nat. Bur. Stand.*, 1940, 25, 379—383).—The finely-ground sample (0.5 g.) is mixed with Na_2CO_3 (0.5 g.) in a 75-mm. Pt dish. If FeO or much Pb is present 0.05 g. of KNO_3 is added. The mixture is spread in a thin layer and covered evenly with Na_2CO_3 (0.5 g.) and heated gradually at first and finally at 1200° during 15 min. After cooling the melt is treated with dil. HCl and evaporated to dryness with this reagent in the usual way. The same Pt vessel is used for ignition of the SiO_2 , thereby eliminating the transference of the whole of the ppt. to the filter-paper. Analyses of various types of minerals and refractories using 1 g. and 4—10 g. of Na_2CO_3 are recorded and compared, the smaller amount of Na_2CO_3 being shown to be sufficient under the fusion conditions used. J. W. S.

Bentonite. M. Guédras (*Rev. Fond. mod.*, 1938, 31, 334—338; 32, 7—10; *Chem. Zentr.*, 1938, ii, 3588).—The mineralogical composition and structure of bentonites and their behaviour with H_2O are reviewed. Analyses are given, and a classification is proposed. Alkali and alkaline-earth bentonites, which contain readily exchangeable cations but are not decomposed by H_2SO_4 , are distinguished. Sub-bentonites also contain exchangeable cations, but their properties are modified by acid. A. J. E. W.

Neptunite crystal. H. Buttgenbach (*Ann. Soc. géol. Belg.*, *Bull.*, 1938, 61, 324—325; *Chem. Zentr.*, 1938, ii, 3524).—Two new faces, (11.11.10) and (21.10.10), have been observed. A. J. E. W.

Dolerites from Portuguese Guinea. E. Polinard (*Ann. Soc. géol. Belg.*, *Bull.*, 1938, 61, 313—322; *Chem. Zentr.*, 1938, ii, 3524).—A petrographic study. The dolerites, like those from French Guinea, consist chiefly of labradorite and pigeonite. Three types, with different hypersthene, biotite, and olivine contents, are distinguished. Three analyses are given. A. J. E. W.

Determination of the volume percentage of mineral components by means of measurement of the light reflected from a polished section. M. Vendl (*Publ. Dept. Min. Met. Roy. Hung. Palatin-Joseph Univ.*, 1934, 6, 285—288).—Components of an ore or a coal are determined by utilising the different reflectivity for light of the components. Intensity measurements are made on a polished specimen by means of a photocell. CH. ABS. (e)

Distinctive isomerism in synthetic and mineral inorganic compounds. A. Quartaroli and O. Belfiori (*Rend. Seminar. Fac. Sci. R. Univ. Cagliari*, 1937, 7, 111—142; *Chem. Zentr.*, 1938, ii, 3380—3381).—A discussion of a possible type of isomerism in which like atoms in a compound, although shown to be equiv. by the ordinary methods of formulation, may not be equiv. chemically; e.g., two forms of $CaHPO_4$, written $Ca_2\{(HPO_4)_2\}$ and $Ca\{Ca(HPO_4)_2\}$, are distinguished. The differences are correlated with observed variations of solubility, action with acids, etc. Other examples considered include $Ca_2(PO_4)_2$, $MgCO_3$, NiS , CoS , CO_2 , $COCl_2$, and H_2O . A. J. E. W.

Age of the uraninite from the McLear pegmatite near Richville station, St. Lawrence Co., N.Y. B. M. Shaub (*Amer. Min.*, 1940, 25, 480—487).—The occurrence of the uraninite

as small cubes in the pegmatite is described, and a chemical analysis [F. Hecht] is recorded. The Pb-U-Th ratio is 0.156, and corresponds with an age of 1094×10^6 years. Pb-U-Th ratios for other areas in Ontario, Quebec, and New York are tabulated and discussed. L. S. T.

Geology of the iron ores of the Collingwood District, N.W. Nelson. M. Gage (*New Zealand J. Sci. Tech.*, 1940, 21, 304—313b).—The geology of the region, the mode of occurrence of the ore, and the available sources of Fe are described, and the ore-forming processes discussed. The limonitic ores of this district resulted from interaction of pyritic minerals with various forms of calcareous rocks, and by direct oxidation of Fe-rich sedimentary minerals and surface concn. of pyrite from deep-seated sources by percolating H_2O . Eight chemical analyses of associated rocks are recorded. L. S. T.

Crystal chemistry of the phosphates, arsenates, and vanadates of the type $A_2XO_4(Z)$. W. E. Richmond (*Amer. Min.*, 1940, 25, 441—479).—The phosphates, arsenates, and vanadates of this type are classified on the basis of their chemical and physical properties into two groups of the type $AXXO_4(Z)$ and $ABXO_4(Z)$. The crystallographic and optical properties and the chemical formulae of the minerals of these groups are tabulated and discussed. X-Ray analyses give the following new vals. for a_0 , b_0 , c_0 and the space-groups: olivenite, $4[Cu_2AsO_4(OH)]$, 8.16, 8.54, 5.86 Å., $D_{2h}^{12}-P2_12_1$; higginsite, $4[CuCaAsO_4(OH)]$, 7.42, 9.20, 5.85 Å., $D_{2h}^{12}-Pnam$; austinite, $4[CaZnAsO_4(OH)]$, 7.43, 9.00, 5.90 Å.; duftite, $4[CuPbAsO_4(OH)]$, 7.50, 9.12, 5.90 Å., $D_{2h}^{12}-Pnam$; pyrobelonite, $4[(Mn,Pb)_2VO_4(OH)]$, 7.84, 9.45, 6.09 Å., $D_{2h}^{12}-Pnam$; sarkinite, $8[Mn_2AsO_4(OH)]$, 12.71, 6.78, 10.20 Å., β 108° 18', $C_{2h}^{12}-C2_a$; tripelite, $16[(Mn,Fe)_2PO_4(OH)]$, 12.03, 6.46, 10.03 Å., β 105° 42', $C_{2h}^{12}-P2_1a$; triploidite, $16[(Mn,Fe)_2PO_4(OH)]$, 12.24, 13.35, 9.88 Å., β 108° 04', $C_{2h}^{12}-P2_1a$; wagnerite, 11.93, 12.47, 9.44 Å., β 108° 09', $C_{2h}^{12}-P2_1a$; amblygonite, $2[(Li,Na)AlPO_4(F,OH)]$, 4.92, 7.05, 4.93 Å., α 107° 23', β 97° 27', γ 109° 50', C_1^1-PI . A new chemical analysis [F. A. Gonyer] of wagnerite from Werfen, Germany, is recorded. L. S. T.

Geochemical prospecting. New method of gas and oil exploration. S. E. Slipper (*Amer. Gas J.*, 1940, 153, No. 2, 31—33).—Geochemical prospecting for oil is based on the theory that gas seepage from an oil deposit takes place slowly by diffusion through overlying strata. On a geological time scale relatively heavy hydrocarbons can diffuse through long distances in minute quantities. Low-temp. fractional distillation methods of gas analysis have made possible a direct method of prospecting for petroleum. Recent work in this field is reviewed. R. B. C.

Geographical distribution of black soil pigment. W. S. Gillam (*J. Amer. Soc. Agron.*, 1939, 31, 371—387).—High org. matter contents in soil are not necessarily paralleled by the content of black pigment, i.e., the org. matter peptised by 4% aq. NH_3 , pptd. by acids, and insol. in EtOH. The relative proportion of pigment in the org. matter was generally greater in the surface than in the subsurface 6-in. layer. The humus colour (aq. NH_3 extract) of soil extracts was \propto the pigment content. In soils from regions of similar rainfall the org. matter (or humus content)—mean annual temp. relationship is represented by a sigmoid curve. For each fall of 10° in mean annual temp. along isohyetal lines the average org. matter and humus contents were doubled, the relative pigment colour was increased 2—6 times, and the relative humus colour 2—3 times. Equal differences in mean temp. had a greater effect on the relative pigment, org. matter, and humus contents of soil in areas of greater rainfall. With increasing rainfall along an isothermal line the average org. matter, relative humus content, and relative pigment content increased curvilinearly and the relative humus colour linearly. With increasing temp. along isohyets the relative pigment content and relative humus colour increased linearly. Addition of org. materials and their subsequent decomp. over a 62-week period caused no appreciable increase in relative pigment content or relative humus colour. The relative humus content of soil types decreased in the order podsol, grey-brown forest soils, red and yellow soils, chernozems, laterites; the relative pigment content and humus colour decreased in the order chernozems, forest soils, laterite, red and yellow soils. The last-named two types were characterised by fairly high humus but low relative pigment contents. A. G. P.

A., I.—General, Physical, and Inorganic Chemistry

MARCH, 1941.

I.—SUB-ATOMICS.

Relative intensities of $^1S \rightarrow ^3P$ and $^1S \rightarrow ^1P$ transitions in Mg. (Miss) P. J. Rubenstein (*Physical Rev.*, 1940, [ii], 58, 1007).—Mathematical. The val. of the parameter suggested by King and Van Vleck (cf. A., 1939, I, 594) to reconcile theoretical with experimental relative intensities is discussed.

N. M. B.

Satellite lines in atomic spectra and the excitation of electrons from closed shells. T. Y. Wu (*Physical Rev.*, 1940, [ii], 58, 1114—1115).—A discussion, based on variational wave-mechanical calculations of energy states, of the explanation of groups of weak lines in the spectra of C v and C vi reported by Edlén (cf. A., 1939, I, 439).

N. M. B.

Broadening, asymmetry, and shift of rubidium resonance lines under different pressures of helium and argon up to 100 atmospheres. S. Y. Ch'en (*Physical Rev.*, 1940, [ii], 58, 1051—1058; cf. A., 1938, I, 53).—Using an improved pressure-tight absorption tube with MgO windows, the effects on Rb resonance lines of He and A up to 100 atm. and H₂ up to 20 atm. were investigated. Up to relative density 46 the broadening \propto the concn. of He or A. The slopes of the half-width-relative density curves are 0.735 and 0.594 cm.⁻¹ per unit relative density of He for $^2P_{3/2}$ and $^2P_{1/2}$ components, respectively, and correspondingly 0.855 and 0.627 cm.⁻¹ for A. He produces a violet and A a red asymmetry, the degree increasing with the concn. of He or A, and comparatively much greater for A. For A the asymmetry of the $^2P_{3/2}$ component is $>$ that of the $^2P_{1/2}$ component; for He the reverse is true. A produces a greater shift (strong red) than that by He (violet). For both gases the shift of the $^2P_{1/2}$ component is $>$ that of the $^2P_{3/2}$ component. For He the shift appears to be \propto the relative density, and the shift of the longer- λ component is \sim twice that of the shorter- λ component; for A the shifts are quite close, and the relation between shifts and relative densities obeys in general the $\frac{1}{2}$ -power relation. Optical collision diameters calc. from half-width data are 13.37 (Rb-A) and 7.753 Å. (Rb-He). Transition probabilities and f vals. are evaluated.

N. M. B.

Pressure effects of hydrogen and nitrogen on the second doublet of Rb principal series. S. Y. Ch'en and C. S. Pao (*Physical Rev.*, 1940, [ii], 58, 1058—1061; cf. A., 1938, I, 53).—At pressures up to 13 atm. for both H₂ and N₂ the $^2P_{3/2}$ broadens more markedly than the $^2P_{1/2}$ component, and the half-width-relative density relation is linear. N₂ produces a red shift for both components, and H₂ gives a weaker red shift for $^2P_{3/2}$ and a stronger violet shift for $^2P_{1/2}$. There is a departure from a linear relationship between shift and density of the perturbing gases. Study of the line contours shows marked asymmetry, towards the red for N₂ and slightly towards the violet for H₂. The relation between half-width and shift is discussed.

N. M. B.

Hyperfine structure in the arc spectrum of bromine. S. Tolansky and S. A. Trivedi (*Nature*, 1940, 146, 687—688).—A correction (cf. A., 1940, I, 335).

L. S. T.

Spectroscopically pure mercury (^{198}Hg). J. Wiens and L. W. Alvarez (*Physical Rev.*, 1940, [ii], 58, 1005).—With a view of obtaining a monochromatic line of an even Hg isotope as a λ standard, the bombardment of Au with slow neutrons from a cyclotron is described. Slow-neutron capture gives radioactive ^{198}Au which emits β -rays (2.7 days) giving ^{198}Hg . A microphotometer trace of the Fabry-Perot spectrogram of the λ 4047 line of this transmutation product shows absence of hyperfine components.

N. M. B.

65

Hyperfine structure and intensities of the forbidden lines of Pb I. S. Mrozowski (*Physical Rev.*, 1940, [ii], 58, 1086—1093).—The lines investigated, in order to establish intensity rules, are those arising from transitions between the levels of the $6p^2$ configuration. They are excited intensely by 3-m. standing waves in He at ~ 5 mm. pressure, containing saturated Pb vapour at 800°. For the quadrupole line λ 5313, the intensity ratio (3:2) and the ratio of the distances from the centre of gravity agree with the Rubinowicz formulae transcribed for hyperfine structure (selection rule $\Delta F = 0, \pm 1, \pm 2$). For the magnetic dipole line λ 4618, these ratios agree with the rules for electric dipole transitions (2:1). For λ 7330 (of mixed type) the intensities are approx. those for ordinary electric dipole transitions, showing that the line is mostly magnetic dipole radiation for which the rule $\Delta F = 0, \pm 1$ holds. The measured relative intensities of these lines and of λ 4659 and a new line λ 9250 ($^3P_2 \rightarrow ^1D_2$) are $I_{4618} : I_{5313} = 5.0 \pm 0.3$, and $I_{4659} : I_{7330} : I_{9250} = 0.023 \pm 0.006 : 1 : 0.84 \pm 0.07$. These ratios are approx. independent of furnace temp.

N. M. B.

Zeeman effect of krypton. J. B. Green, D. W. Bowman, and E. H. Hurlburt (*Physical Rev.*, 1940, [ii], 58, 1094—1098).—Full data on the Zeeman effect of ~ 130 lines in the spectrum of neutral Kr are tabulated, and yield a large additional no. of g vals. The g sum rule is verified for $4p^5s$, $4p^5p$, and for $J = 2$ of $4p^5p$. Anomalies in the g vals. are discussed.

N. M. B.

Copper K -absorption spectrum of aluminium-copper alloys and the problem of their improvement. S. Kokubo and T. Hayasi (*Sci. Rep. Tôhoku*, 1940, 29, 384—390; cf. A., 1937, I, 159).—The fine structure of the Cu K -absorption edge in Al-Cu alloys containing 5% Cu has been correlated with the heat-treatment of the alloys and compared with that of the compound CuAl₂. The structures are similar for CuAl₂ and for the alloy after 30 min. heating at 545° followed by slow cooling. The structures of the K -edge for alloy samples heated at 545° for 30 min. and then quenched in cold H₂O are similar before and after annealing for 6 hr. at 200°, but differ from that for CuAl₂. The significance of these results for the hardening process in Cu-Al alloys is discussed.

O. D. S.

Mobilities in hydrogen at high current densities. W. H. Bennett (*Physical Rev.*, 1940, [ii], 58, 992—997).—In an investigation of the silent electric discharge from sharp points and fine wires in H₂ at atm. pressure the conditions are such that the discharge itself purified the gas from electron-attaching impurities, and favour free electron conduction. Measurements are reported of the generalised coeff. of mobility for the drift of free electrons in H₂ and of the mobility of H₂⁺ in H₂ (cf. Bradbury, A., 1936, 540).

N. M. B.

Double scattering of high-speed electrons by a gold and an aluminium target. Magnetic spectra of doubly scattered electrons. K. Kikuchi (*Sci. Rep. Tôhoku*, 1940, 29, 423—429, 430—439).—I. The magnetic spectrum of 42—86-kv. electrons scattered from a Au (polarising) and an Al (analysing) target has been investigated. The spectrum shows no asymmetry comparable with that previously observed (*Proc. Phys.-Math. Soc. Japan*, 1940, 22, No. 10) for double scattering from two Au targets. This agrees with Mott's theory (A., 1932, 441). The asymmetry for two Au targets is in numerical agreement with the theory.

II. The shapes of the magnetic spectra of electrons doubly scattered from a Au and an Al target or from two targets are compared with those of Wagner for single scattering by Au (A., 1930, 269). It is concluded that elastic single scattering is relatively frequent for targets having thicknesses satisfying Wentzel's criterion. With increasing target thickness the

66

tail of the elastic peak at first becomes more marked but rapidly reaches a const. val. The thickness of the Au targets used by Dymond (A., 1932, 789) does not satisfy Wentzel's criterion and, therefore, the observed asymmetry of doubly scattered electrons does not correspond with that predicted by Mott (*ibid.*). O. D. S.

Secondary electron emission of nickel at the Curie point. P. S. Varadachari (*Proc. Indian Acad. Sci.*, 1940, 12, A, 381—390).—Secondary electron emission from Ni has been investigated at various applied potentials from 30° to 470°. At the Curie point (358°) the secondary electron current does not suddenly alter; this is contrary to existing results of Tartakowsky *et al.* (A., 1932, 553) and Hayakawa (A., 1934, 233). W. R. A.

Decrease in ionisation of the F_2 region during solar eclipse. J. A. Pierce, A. J. Higgs, and E. C. Halliday (*Physical Rev.*, 1940, [ii], 58, 1119, and *Nature*, 1940, 146, 747).—During the total eclipse of 1 Oct., 1940, ionospheric observations at 3 points in South Africa showed a marked ultra-violet light effect in the F_2 region; the max. electron density decreased by ~20% to a min. ~30 min. after totality. There was no evidence for corpuscular effects. N. M. B.

Recombination and electron attachment in the F layers of the ionosphere. F. L. Mohler (*J. Res. Nat. Bur. Stand.*, 1940, 25, 507—518).—Observations at Washington indicate that the rate of recombination of electrons in the ionosphere at night is approx. $\propto c^2$ (c = electron concn.), but the apparent recombination coeff. α' tends to increase with decreasing c over the half period of a sunspot cycle. This, and the variation of α' with height, indicate that electrons disappear both through recombination and through negative ion formation. The daily variation of c indicates that the F_2 layer is above, and the F_1 layer is near, the level at which the rate of production of electrons is a max. in midsummer. It is assumed that both layers arise through ionisation of at. O. The calc. val. of the pressure (p) of max. c , and the ratio p/p_0 (p_0 = pressure at the F_1 level), are in accord with the theory of recombination. Seasonal variations in p/p_0 and in c are explained. The effective collision area for electron attachment to at. O is 6×10^{-21} cm.² J. W. S.

High-velocity atomic beams. I. Amdur and H. Pearlman (*J. Chem. Physics*, 1940, 8, 998).—A correction (cf. A., 1940, I, 89). J. W. S.

$^{12}\text{CH}_2$ — ^{14}N mass difference. E. B. Jordan (*Physical Rev.*, 1940, [ii], 58, 1009—1010).—Using a new type of mass spectrograph of very high resolving power and dispersion, preliminary measurements give an average mass difference of 0.01256 ± 0.000015 . N. M. B.

Search for element 85. E. B. Andersen (*Kgl. Danske Vidensk. Selsk., Mat.-fys. Medd.*, 1938, 16, No. 5, 18 pp.; *Chem. Zentr.*, 1938, ii, 3663).—A review compiled from notebooks of U. Keel. Attempts to extract a radioactive analogue of I from thorite, Ra-D, stibnite, antimonite, other sulphide minerals, etc. have failed. The methods of separation and purification are described in detail. A. J. E. W.

Velocity spectrum of α -particles. R. Ringo (*Physical Rev.*, 1940, [ii], 58, 942—948).—A 60° magnetic α -particle spectrograph and its use on a no. of natural α -particle emitters, with photographic plates to detect the particles, are described. The energy of the main group of Pa α -particles was found to be 5.053 ± 0.007 Me.v. With the thinnest sources of Po, Th-C, and Th-C' α -particles, as many as 10% of the particles had energies $< 5\%$ below the energy of the max. in any one group. N. M. B.

Neutron-proton scattering at high energies. C. F. Powell, H. Heitler, and F. C. Champion (*Nature*, 1940, 146, 716—717).—The scattering of 8-Me.v. neutrons from B + D by protons has been investigated. The experimental curve for angular scattering agrees with that obtained by assuming scattering to be isotropical about the centre of mass of the colliding particles. L. S. T.

Electrostatic deflexion studies of α -particles; the α -particles from ^6Li (p, α) ^3He . L. C. Miller (*Physical Rev.*, 1940, [ii], 58, 935—942).—A technique is described for studying nuclear reactions in which short-range α -particles are produced with too small a yield for direct application of the electrostatic deflector (cf. Allison, A., 1938, I, 489). A strong Po source is used to supply to the deflector α -particles; a group of these,

homogeneous in energy, passes through and enters a variable-pressure absorption cell and ionisation chamber. Cut-off pressures, determined for various α -particle energies, result in a calibrated cell which can be used to determine the α -particle energies in nuclear disintegration. Application to ^6Li (p, α) ^3He gives a Q val. of 3.94 ± 0.08 Me.v. The calibration for 1—1.8-Me.v. α -particle energy is also used to determine the slope of the range-energy curve. Its average val. for this region is 200 kv. per mm. range. N. M. B.

Possible scheme for the assignment and prediction of radioactive periods. G. R. Dickson and E. J. Konopinski (*Physical Rev.*, 1940, [ii], 58, 949—951; cf. Wigner, A., 1937, I, 110).—Families of odd nuclei differing from each other only by α -units show some evidence of a type of regularity in their stability against β -processes. The assumption of a similar regularity for all such families permits the unique assignment to the correct isotope of many known radioactive periods and the prediction of many yet unknown lifetimes. Results for 21 and 52 cases, respectively, are tabulated. N. M. B.

Scattering of 20° neutrons in o - and p -hydrogen. L. W. Alvarez and K. S. Pitzer (*Physical Rev.*, 1940, [ii], 58, 1003—1004).—Measurements with improved apparatus are reported. The true scattering cross-sections are $\sigma_o = (100 \pm 3) \times 10^{-24}$ and $\sigma_p = (5.2 \pm 0.6) \times 10^{-24}$ sq. cm.; hence $\sigma_o/\sigma_p = 19$, compared with 2—5 from earlier work, the low val. being due probably to excess scattering of faster neutrons in p -H₂ (cf. Libby, A., 1939, I, 232). N. M. B.

Neutron scattering in o - and p -hydrogen and the range of nuclear forces. J. Schwinger (*Physical Rev.*, 1940, [ii], 58, 1004—1005).—Mathematical. The results of scattering measurements (cf. preceding abstract) cannot be reconciled with calc. singlet and triplet scattering amplitudes, the corresponding cross-sections, and the force range, based on present theory. N. M. B.

Ground states of ^{10}Be and ^{10}C . E. P. Cooper and E. C. Nelson (*Physical Rev.*, 1940, [ii], 58, 1117).—Considerations based on energy relations in the anomalous decay of ^{10}Be (~ 10^6 years) into stable $^{10}\text{B} + 550$ -ke.v. β -particles and the contrasting decay of ^{10}C (9 sec.) into $^{10}\text{B} + 3.36$ -Me.v. positrons lead to the conclusion either that the level spacing given by the Hartree approximation is in error by $>$ an order of magnitude, or that some asymmetry other than the known electromagnetic forces must appear in nuclear interactions. N. M. B.

Thresholds for the proton-neutron reactions of lithium, beryllium, boron, and carbon. R. O. Haxby, W. E. Shouppe, W. E. Stephens, and W. H. Wells (*Physical Rev.*, 1940, [ii], 58, 1035—1042).—Energy thresholds for neutron production by bombardment of targets with high-energy protons from a pressure electrostatic generator, measured with a BF₃ ionisation chamber surrounded with paraffin, as a neutron detector, are: ^7Li , 1.86; ^9Be , 2.03; ^{11}B , 2.97; and ^{12}C , 3.20 Me.v. From these vals. the calc. mass differences are: ^7Be — ^7Li , 0.87; ^9B — ^9Be , 1.08; ^{11}C — ^{11}B , 1.97; and ^{12}N — ^{12}C , 2.22 Me.v. ^9B is shown to be unstable with respect to disintegration into $^8\text{Be} + ^1\text{H}$. The ^{12}N — ^{12}C difference agrees closely with the max. positron energy from ^{12}N . N. M. B.

(A) **Protons from carbon and aluminium bombarded by deuterons.** H. L. Schultz, W. L. Davidson, jun., and L. H. Ott. (B) **Protons from separated isotopes of carbon and neon under deuteron bombardment.** H. L. Schultz and W. W. Watson (*Physical Rev.*, 1940, [ii], 58, 1043—1047, 1047—1050).—(A) To overcome difficulties arising from the use of proportional counters and ionisation chambers, a special moving-diaphragm type cloud chamber was used to study the protons from bombardment of C and Al with 3.2-Me.v. deuterons from a cyclotron. The group corresponding with the ground state of ^{12}C appears to be single. The general distribution of protons from ^{27}Al accords with the findings of McMillan (cf. A., 1935, 559), but the large no. of closely spaced groups renders analysis into groups difficult. Curves are given from which any group structure can be inferred. As tested by scattering from thin Au foil, the deuteron beam is homogeneous to within 0.15 Me.v.

(B) A cloud-chamber study of the protons arising from the bombardment by 2.54-Me.v. deuterons of CH₄ gas enriched in ^{13}C and Ne enriched in ^{20}Ne shows that the yield of long-range protons from the ^{13}C (d, p) ^{14}C reaction is $< 4\%$ of the yield of shorter-range protons from the ^{12}C (d, p) ^{13}C reaction at

this deuteron energy. This indicates that the half-life of ^{14}C is ~ 100 years compared with 1000 years as estimated by Ruben (cf. A., 1940, I, 186). In Ne the longest range group of protons (cf. Pollard, A., 1940, I, 340) is complex, with an indicated doublet width of the ground state of ^{21}Ne of 0.44 Me.v. The only proton group definitely indicated for the ^{22}Ne bombardment occurs at ~ 30 cm. range. N. M. B.

Artificial radioactivity of caesium induced by neutrons. E. Rona and H. Scheichenberger (*Anz. Akad. Wiss. Wien, math.-nat. Kl.*, 1938, 56; *Chem. Zentr.*, 1938, ii, 3653).—Irradiation of CsNO_3 with slow neutrons from 250–550-millicurie Ra-Be and Rn-Be sources induces β -activity with a half-life of several months; the half-val. thickness of Al for the β -radiation is 0.16 mm. Other short-lived activities (cf. Latimer *et al.*, A., 1935, 678) have not been observed. A. J. E. W.

Proton-induced radioactivity of manganese. A. Hemmendinger (*Physical Rev.*, 1940, [ii], 58, 929–934).—The reaction $^{52}\text{Cr}(p, n)^{52}\text{Mn}$ at 6.6 Me.v. proton energy produces isomerides with periods 21.3 min. and 6.5 days (cf. Livingood, A., 1938, I, 594). These are positron emitters with max. positron energy 2.2 and 0.77 Me.v., respectively. The 21-min. activity emits 2 γ -rays per positron. The γ -radiation in the 6.5-day activity is so intense that 95% of these disintegrations must be due to K-electron capture; this is followed by emission of probably 2 γ -rays. In the remaining 5% the positron emission is followed by 3 γ -rays. For the 21-min. and 6.5-day activities the yields are 0.40×10^{-6} and 0.68×10^{-6} , and the thresholds 6.2 and ~ 6.2 Me.v., respectively. N. M. B.

γ -Radiation from rhenium. E. Creutz, W. H. Barkas, and N. H. Furman (*Physical Rev.*, 1940, [ii], 58, 1008).—Proton bombardment of W produced the long-period isotope obtained by Fajans (cf. A., 1940, I, 384) by W (D, n) and Re ($n, 2n$), and assigned to ^{181}Re . The half-life found is 54 ± 2 days. The 90-hr. and 30-min. periods were also produced by proton bombardment. Absorption measurements of the radiation from the 54-day product showed negative electrons of ranges corresponding with ~ 0.1 , 0.22, and 0.86 Me.v., and γ -radiation of ~ 1 Me.v. The highest-energy group may be conversion electrons from this γ -ray. A long exposure showed a line at 0.096 Me.v. If these are K-conversion electrons there must be a γ -ray from the 54-day isotope of 0.096 ± 0.071 (Re K edge) = 0.17 Me.v. N. M. B.

Counter studies on cosmic rays at sea level. G. O. Altmann, H. N. Walker, and V. F. Hess (*Physical Rev.*, 1940, [ii], 58, 1011–1017).—Extensive studies of Rossi transition curves for Pb up to 400 g. per sq. cm. showed no evidence of a second max. (cf. Bothe, A., 1939, I, 190). Coincidence counter recordings of time variations of cosmic rays with temp. and pressure, and of various non-periodic changes in intensity due to the passage of cold and warm fronts, barometric depressions, and magnetic storms are reported and discussed. N. M. B.

Genetic relation between the electronic and mesotronic components of cosmic rays near and above sea level. G. Bernardini, B. N. Cacciapuoti, B. Ferretti, O. Piccioni, and G. C. Wick (*Physical Rev.*, 1940, [ii], 58, 1017–1026; cf. A., 1940, I, 309).—The hypothesis that cosmic-ray electrons observed at sea level are mostly due to mesotron disintegration was tested by comparing the ratio soft/hard component, at sea level in free air, with the same ratio at 2050 m. under a dense absorbing layer; by comparing Rossi curves for small showers under the same conditions; and by a detailed study of the increase of the soft component with altitude. Results indicate that the proper lifetime of the mesotron is $< 4 \mu$ -sec. and that the soft radiation observed at sea level is not entirely due to secondary processes of the mesotron. N. M. B.

Cosmic rays and comets. V. Rojansky (*Physical Rev.*, 1940, [ii], 58, 1010).—A discussion of methods and opportune conditions for testing the conjecture that comets are contraterrene bodies (composed of hypothetical atoms consisting of negatively charged nuclei surrounded by positrons). Among the products of mutual annihilation of terrene (ordinary) and contraterrene matter there may be free mesons. This suggests that the continual release of mesons at the top of the earth's atm. may be caused by contraterrene matter from interstellar space impinging on the atm., and that non-ionising particles which release mesons deeper in the atm.

may be contraterrene neutrons set free in the earlier stages of the annihilation of the impinging contraterrene at. nuclei.

N. M. B.

Production and absorption of mesotrons in the substratosphere. M. Schein, E. O. Wollan, and G. Groetzinger (*Physical Rev.*, 1940, [ii], 58, 1027–1031; cf. A., 1940, I, 308).—Coincidence-counter attempts, at altitudes up to 9.3 km., to observe mesotron production in an 8-cm. Pb block by some non-ionising radiation other than photons indicate that the no. of mesotrons so created is $> \sim 5\%$ of the total no. of mesotrons at this altitude. From data for mesotron absorption in Pb as a function of altitude, an energy spectrum of mesotrons at 6.7 km. is constructed. At 6.7 km. $\sim 33\%$ of the mesotrons have energies $< 5.2 \times 10^8$ e.v., and at sea level only a very small fraction of the mesotrons have energies in this range, in agreement with the observations of Herzog (cf. *ibid.*, 188). N. M. B.

Vertical shift of the meso-formation layer. H. Arakawa (*Physical Rev.*, 1940, [ii], 58, 1118–1119; cf. Loughridge, A., 1940, I, 54).—Mathematical. An expression in conformity with aerological standards is deduced for vertical shift due to temp. or pressure. N. M. B.

Existence and magnitude of electronic charges. A. Landé (*J. Franklin Inst.*, 1940, 229, 767–774).—Mathematical. For the quantisation of Dirac's classical point electron Einstein's classical equation is supplemented with a reciprocal classical equation. A transcendental equation is obtained for the eigen-val. μ , which is the product of the fine structure const. α and the factor γ in Dirac's signal radius $\gamma e^2/mc^2$, giving $\mu_{\text{min.}} = 0.0299$. W. J.

Electromagnetic properties of mesotrons. H. C. Corben and J. Schwinger (*Physical Rev.*, 1940, [ii], 58, 953–968).—Mathematical. A general theory describing particles of unit spin and arbitrary magnetic moment is developed and applied to the motion of such particles in a Coulomb field. The exact equations for the radial components of the wave functions are discussed both for particles with a magnetic moment unity (Proca theory) and for those with a magnetic moment of two meson magnetons. N. M. B.

Mesons in a Coulomb field. I. Tamm (*Physical Rev.*, 1940, [ii], 58, 952).—Mathematical. The regular solutions of the Proca equations in a field of a point charge do not form a complete set of functions and the problem of the Coulomb scattering of mesons has no solution. This breakdown of theory arises from neglect of the finite size of elementary particles. N. M. B.

Nature of nuclear forces. L. Landau and I. Tamm (*Physical Rev.*, 1940, [ii], 58, 1006; cf. preceding abstract).—Mathematical. Considerations lead to the view that nuclear forces originate from the electrical interaction of the nuclear particles by means of the mesotrons, and are connected with the peculiar properties of the equations of motion of the mesotrons. N. M. B.

Theory of mesons. C. Møller (*Physical Rev.*, 1940, [ii], 58, 1118).—A discussion and amplification of the theory of meson fields previously reported (cf. *Kgl. Danske Vidensk. Selsk., Mat.-fys. Medd.*, 1940, 17, 8). N. M. B.

"Radius" of the elementary particle. L. Landau (*Physical Rev.*, 1940, [ii], 58, 1006–1007).—Mathematical. There are no reasons to assume that the limits of applicability of the electrodynamical conceptions in quantum mechanics are given by e^2/mc^2 . A simple method is developed to find, in quantum theory, the limit beyond which the theory comes into contradiction with itself because of the neglect of the reaction of the field. N. M. B.

Magnetic resonance method of determining nuclear moments. A. F. Stevenson (*Physical Rev.*, 1940, [ii], 58, 1061–1067).—Mathematical. A quant. examination of refinements of the theory of the method, as given by a correction for the use of an oscillating rather than a rotating field, and by taking into account the "end effect" (cf. Millman, A., 1939, I, 297). N. M. B.

Scattering matrix of radioactive states. G. Breit (*Physical Rev.*, 1940, [ii], 58, 1068–1074; cf. A., 1940, I, 428).—Mathematical. The method of complex eigen-val. is generalised to many-dimensional problems by means of the scattering matrix (cf. Wheeler, A., 1938, I, 57). N. M. B.

Possible rôle of neutrinos in stellar evolutions. G. Gamow and M. Schoenberg (*Physical Rev.*, 1940, [ii], 58, 1117).—In progressively contracting stars, when the density and temp. in the interior become high enough to permit the penetration of free electrons into different nuclei with formation of unstable isobars of smaller at. no., the neutrinos produced cannot be held back by gaseous walls surrounding the central region. Thus no thermodynamic equilibrium is possible, and the matter rapidly loses its extra heat content through the neutrino emission. Under such conditions the slow contraction will give place to a rapid collapse. N. M. B.

II.—MOLECULAR STRUCTURE.

Intensity changes in Cameron bands of carbon monoxide excited by electron impact. G. E. Hansche (*Physical Rev.*, 1940, [ii], 58, 1075—1077).—Relative intensities of the $^3\Pi-^2\Sigma$ Cameron bands and the $^4\Pi-^2\Sigma$ fourth positive bands of CO excited by impact of electrons of various energies at various pressures indicate that intense Cameron bands can be obtained at pressures up to 0.025 mm. in contrast with an upper limit of 0.005 mm. in electrodeless-discharge experiments (cf. A., 1940, I, 192), and that the excitation function of the Cameron bands has two max., as in the case of a $^2P-^1S$ at. transition. N. M. B.

Visible fluorescence bands of cadmium vapour. A. Kotecki (*Acta phys. polon.*, 1937, 6, 144—149; *Chem. Zentr.*, 1938, ii, 3653—3654).—The intensity distribution of the bands, which depends on the temp. of the vapour and the λ of the exciting light, is studied, and conclusions concerning the 2^3P_1 state of the Cd_2 mol. are recorded. A. J. E. W.

Frequencies ν_2 and ν_1 in the infra-red spectra of SiH_4 and GeH_4 . J. W. Straley, C. H. Tindal, and H. H. Nielsen (*Physical Rev.*, 1940, [ii], 58, 1002; cf. A., 1940, I, 60).—Suggested interpretations are discussed. A re-examination of the spectra under higher resolving power confirms available data, and, in the case of SiH_4 , shows the secondary peak near 10.3μ . as a Q branch of a weaker band extending to 9.0μ . The bands at 11.0 and 10.3μ . are identified with frequencies ν_4 and ν_2 , respectively. For GeH_4 , there exists at longer λ a region of more intense absorption. Measurements and almost complete resolution were obtained for $9-13 \mu$.; they reveal a convergence towards higher frequencies in the band ν_4 and towards lower frequencies in the band ν_2 . N. M. B.

Absorption of light in solid and liquid ammonia. I. Absorption spectrum from (I) 5000 to 2000 Å., (II) 10,140 to 5000 Å. A. Prichotko (*Acta Physicochim. U.R.S.S.*, 1940, 12, 559—564, 565—572).—I. The absorption spectrum of the liquid and the cryst. solid was measured for layers 1—28 mm. thick at temp. very near the m.p. The absorption is continuous; the low-frequency end begins at λ 2345 Å. for the liquid and 2116 Å. for the solid, compared with 2430 Å. for the gas. The large displacements observed are ascribed to changes in the electronic shell caused by mol. association.

II. The infra-red spectra of liquid and solid NH_3 are similar to one another but entirely different from that of the gas. Three of the bands in the liquid become doublets in the solid. A provisional interpretation is offered. F. I. U.

Absorption spectra of europium ion in some hydrated salts. F. H. Spedding, C. C. Moss, and R. C. Waller (*J. Chem. Physics*, 1940, 8, 908—918).—The absorption spectra of cryst. $EuCl_3 \cdot 6H_2O$, $EuBr_3 \cdot 6H_2O$, and $Eu_2(SO_4)_3 \cdot 8H_2O$ have been measured over the λ range 6150—2900 Å. at 78° and 298° K. Evidence is obtained for the existence of 300, 385, 938, and 970 cm^{-1} energy levels, and for the possibility of an energy level at 435 cm^{-1} . Decrease of temp. from 298° to 78° K. shifts the lines $\sim 10 \text{ cm}^{-1}$. Certain smaller frequency intervals are attributed to vibrational and oscillational frequencies superimposed on the electronic frequency. J. W. S.

Infra-red spectrum and internal torsion of dimethyl sulphide. H. W. Thompson (*Trans. Faraday Soc.*, 1941, 37, 38—45).—Absorption spectra of Me_2S at various pressures have been measured in the range 1—16 μ . The data differ from those of Fonteyne (A., 1940, I, 95) in two significant ways. The total entropy calc. on the basis of the present frequency assignments is 69.20, against the measured val. 69.35. F. L. U.

Absorption spectra of co-ordination compounds. IV. Ethylenediamine cobaltic complexes. H. Kuroya and R. Tsuchida (*Bull. Chem. Soc. Japan*, 1940, 15, 427—439; cf. A., 1938, I, 385, 432, 493).—The absorption spectra of a no. of complexes of Co^{III} with $(CH_2NH_2)_2$ (I) are recorded in curves and tables. Generally the first, second, and third absorption bands are shifted towards shorter λ , and the extinction coeffs. are increased, as compared with those of the corresponding NH_3 complexes. In analogous Co and Cr complexes, the first band of the Co compound is displaced to longer λ , and the second band is displaced to shorter λ , as compared with the corresponding bands of the Cr compound. These results accord with the view that the second band, but not the first, is an index of the stability of the complex, being due to the co-ordination electrons. The greater stability of (I) complexes is explained on structural grounds. J. W. S.

Spectral investigation of chemical processes in organic compounds at low temperatures. I. A. Terenin (*Acta Physicochim. U.R.S.S.*, 1940, 12, 617—636).—The fluorescence spectra of $PhCHO$ (I) and some related substances in thin films ($\sim 0.1 \mu$. by vac. condensation) at -180° have been studied. For (I), the spectrum is shifted towards longer λ , and the vibrational frequency of the carbonyl group ($\Delta\nu$) is 1560 cm^{-1} , instead of 1730 cm^{-1} as compared with the gas phase. Thin films of dil. solutions of (I) in H_2O , $EtOH$, C_6H_6 , and $COMe$, obtained by vac. condensation of the solvent in presence of traces of (I), give spectra at -180° in which $\Delta\nu$ is 1600—1620 cm^{-1} ; this val. is considered to be characteristic of the isolated (I) mol. at -180° . With increasing dipole moment of the solvent the max. become more diffuse, although their position is unchanged. This is ascribed to electrostatic interaction. The val. 1560 cm^{-1} in the solid film is considered to indicate association to double mols. by H bond formation. When the film of (I) is quickly warmed to -20° and again cooled the fluorescence changes to an intense green with a max. at 5300 Å., suggesting the formation of benzoin. Fluorescence spectra under similar conditions are also recorded for $COPhMe$, $(CH_2Ph)_2$, $BzOH$, CH_2Ph-OH , and hydrobenzoin. F. J. G.

Raman effect of oxonium compounds. A. R. Gantmacher, M. W. Wolkenstein, and J. K. Sirkin (*Acta Physicochim. U.R.S.S.*, 1940, 12, 786—792).—Raman spectra for systems $Me_2O + nHCl$ ($n = 1, 2, 3$) between -80° and 20° are recorded. With increasing $[HCl]$ and falling temp. a new line at $\Delta\nu \sim 500 \text{ cm}^{-1}$ and a new diffuse band at $\Delta\nu \sim 2400 \text{ cm}^{-1}$ appear. The latter is attributed to strongly deformed HCl in a structure $Me_2O \cdots H-Cl \cdots H-Cl$, stabilised by resonance with $Me_2OH^+Cl^- \cdots HCl$, analogous to the HF_2^+ ion. The line $\sim 500 \text{ cm}^{-1}$ would correspond with the hindered rotation of the second Cl atom. Reasons based on energetics are given for rejecting structures with 4-covalent O. F. J. G.

Absorption spectra of metallic complex salts of 2:2'-dipyridyl. IV. K. Yamasaki (*Bull. Chem. Soc. Japan*, 1940, 15, 461—465; cf. A., 1940, I, 344).—Absorption curves (200—700 $m\mu$.) are recorded for $[FeR_2]Cl_2$, $[FeR_2(CN)_2]$, $[FeR(CN)_4]K_2$, and $[FeR_2]Cl_3$ ($R = 2:2'$ -dipyridyl). ϵ for the band $\sim 295 \text{ m}\mu$. is approx. \propto the no. of R mols. in the complex. Replacement of R by CN causes a progressive shift towards the violet. F. J. G.

Structural interpretations of flavone spectra. S. Aronoff (*J. Org. Chem.*, 1940, 5, 561—571).—The ultra-violet spectrum of flavone shows two well-defined bands at 3000 and 2500 Å. (with a further band at 2000 Å.). C_6H_6 and pyrene show max. at 2000 and 2500 Å. but annelation of the two mols. produces a new band. Substitution of Ph at C_2 does not shift basically any of the absorption bands and thus does not, *per se*, affect the nucleus. Flavanone (I) shows two bands beyond 2000 Å., one at 2500 and another at 3200. Disruption of the quinoidal structure of the pyrone in benzopyrone shifts one of the bands to the red, so that this structure is not in itself responsible for the two bands beyond 2000 Å. Since α -hydroxybenzylacetophenone has an absorption spectrum similar to that of (I), even a chromone structure is not necessary to produce the "characteristic" flavone spectrum. What appears requisite is O on the phenone to complete (either directly or by chelation) a two-ringed system or, more explicitly, to give *o*- or *p*-resonance (*m*-resonance is negligible with the large bond distances involved). In monohydroxyflavones OH at $C_{4'}$, $C_{7'}$, or $C_{8'}$ causes a shift of the 3000 Å. band, the order (as given) being

α the length of the conjugation chain. OH at $C_{(2)}$ or $C_{(3)}$ produces no shift, whereas OH at $C_{(4)}$ creates a new band beyond 2500 and 3000 Å. without altering the 2500 Å. band (3000 Å. band doubtful). 5- and 6-Hydroxyflavone shift the 2500 Å. band, the former also shifting the 3000 Å. band. The connected resonances are described. It is concluded that owing to restriction of the normal resonance of the pyrylium nucleus by ketonic O, the additional resonances caused by substitutions follow a path through this O resulting in a red-shift of one band. Where such resonances cannot occur, either the resonance is identical with flavone or a tautomerism involving much more energy predominates. An exception is made with substitution of OH at $C_{(3)}$ where, although a resonance form similar to 7-OH exists, a rearrangement to a ketonic (I) occurs most readily. Among polyhydroxyflavones, except where additional resonance forms may exist, the resultant λ of the absorption bands lie on the max. position of each band with regard to the substituted OH. In most cases, however, especially those involving OH at $C_{(4)}$, there is a large shift indicating that the additional resonance involves a still larger energy absorption. Since the chain length is greatest through 4', the shift is also proportionately greater with compounds of this derivative. This applies also to $(OH)_3$ - and $(OH)_4$ -substitutions. H. W.

Infra-red absorption of proteins in the 3 μ . region. XII. A. M. Buswell, K. F. Krebs, and W. H. Rodebush (*J. Physical Chem.*, 1940, **44**, 1126—1137).—Absorption bands of 16 proteins and 11 related compounds are tabulated. All the proteins show peaks at 3.00, 3.22, and $\sim 3.4 \mu$, whilst salmine shows additional absorption at 3.09 μ . Absorption at 3.00 μ is due to a single NH—O bond and at 3.22 μ to double NH—O bonds in a ring-dimeride structure (two peptide links bonded NH to O). The band due to the latter linking is relatively strong for gelatin and peptone but is much less pronounced for natural proteins, especially if the method of isolating the protein has not been drastic. It is suggested that in natural proteins excess H_2O attaches to half of the hydrophilic groups, thus preventing ring formation. Drastic dehydration irreversibly removes this H_2O and permits ring formation. Absorption at $\sim 3.4 \mu$ is due to C—H bonding, and the additional absorption shown by salmine is attributed to excess NH_2 . C. R. H.

Raman spectra of esters of dicarboxylic acids. Oxalyl chloride, ethyl and methyl oxalates, ethyl malonate, fumarate, and maleate, and oxalic acid. B. D. Saksena (*Proc. Indian Acad. Sci.*, 1940, **12**, A, 416—426).—Raman spectra and the polarisation of the lines have been investigated. All these compounds possess free rotation around the C—C linking and are capable of occurring as *cis*- or *trans*-isomerides which, by virtue of different symmetry, exhibit different spectroscopic characteristics. Frequencies for $H_2C_2O_4$ and $(COCl)_2$ and their polarisation characteristics have been calc. on the *trans* model and agree with ascertained data. $Me_2C_2O_4$ shows striking changes in passing from the solid to the liquid state. This is attributed to the transformation from $-C \begin{smallmatrix} \diagup O \\ \diagdown O \end{smallmatrix} R$ to



W. R. A.

Triboluminescence of sugars. (Miss) F. G. Wick (*J. Opt. Soc. Amer.*, 1940, **30**, 302—306; cf. A., 1937, I, 599).—Sucrose, maltose, and lactose crystals phosphoresce after exposure to an Fe spark at room temp.; at liquid air temp. this phosphorescence and triboluminescence are much more intense. Addition to the sugar of oils or dyes which are excited to fluorescence by the Fe spark also increases the triboluminescence intensity, and the intensities of triboluminescence and fluorescence are max. in similar temp. ranges; oils which increase the phosphorescence but not the fluorescence of the sugar have no effect. Amorphous carbohydrates (including caramelised sucrose) are phosphorescent, particularly at low temp., but not triboluminescent. These experiments confirm that triboluminescence is partly due to fluorescence excited by an electric discharge caused by fracture of the crystals. Triboluminescence which is increased in intensity by fluorescent materials is also produced in sugars by sudden cooling to or heating from liquid air temp. At liquid air temp. ice is phosphorescent and triboluminescent, and the triboluminescence intensity is increased by previous irradiation with the Fe spark. A. J. E. W.

Mechanism of spark discharge in air at atmospheric pressure. II. L. B. Loeb and J. M. Meek (*J. Appl. Physics*, 1940, **11**, 459—474; cf. A., 1940, I, 276).—There are two possible mechanisms of spark discharge, that due to Townsend and Holst, which holds for vals. of $p\delta$ (p = pressure, δ = spark gap) from < min. sparking potential up to ~ 100 , and that due to Meek, based on positive-ion space-charge streamer formation, which holds for vals. of $p\delta > 100$. An approx. expression for the tip-field of the positive space-charge in the streamer, if the streamer is to be propagated, is worked out, and applied to spark breakdown at atm. pressure. Results worked out from the theory give a small deviation from Paschen's law. The equation has been tested for H_2 and other gases with satisfactory results. The theory gives results deviating from experiment at vals. of $p\delta$ where streamer formation ceases to be possible, and the Townsend-Holst theory becomes applicable. The effect of illumination of the cathode with ultra-violet light on the spark potential is discussed, and shown not to affect the streamer theory. The conditions necessary for streamer and avalanche propagation are discussed. For long sparks, the Meek criterion for sparking no longer applies, but sparks progress by avalanche advance and retrograde streamers. The Townsend mechanism also does not apply. The mechanism of the lightning discharge is discussed. A. J. M.

Electrical conductivity. G. Calcagni (*Separate*, Genoa, 1940, 56 pp.).—A theory of electrical conduction in metals and electrolytes is proposed and discussed, in which the occurrence of electrical phenomena is attributed to the action of various forms of energy on the interat. and intermol. forces in matter. O. J. W.

Formulae for the natural dispersion of some organic liquids. W. J. C. Beynon (*Phil. Mag.*, 1941, [vii], **31**, 1—12).—The dispersions of MeOH, EtOH, PrOH, BuOH, and $CH_3(CH_2)_3OH$ over the range 3000—20,000 Å. can be represented by $n^2 - 1 = b_0 + \sum b_r/(\lambda^2 - \lambda_r^2) - b_\infty\lambda^2/(\lambda_\infty^2 - \lambda^2)$, where n is the refractive index for wave-length λ , and b_0 , b_r , b_∞ , λ_r , and λ_∞ are consts. The consts. λ_r are identified with the absorption bands of the substances in the vapour state in the extreme ultra-violet region, and λ_∞ is the wave-length of the infra-red absorption band at $\sim 3.2 \mu$. From the consts. of these formulae and those of the corresponding magneto-optical dispersion formulae (A., 1938, I, 226) the val. of e/m for the resonator responsible for the dispersion is calc. as $0.93 - 1.14 \times 10^{-17}$ c.m.u., the val. increasing with increasing ν and generally with increasing mol. wt. The vals., however, are all < the accepted vals. for the electron. J. W. S.

Complex rotatory dispersion of optically active tetrahydrofuryl-2-carbinol. M. P. Balfe, M. Irwin, and J. Kenyon (*Nature*, 1940, **146**, 686).—The *d*- and *l*-rotatory forms of tetrahydrofuryl-2-carbinol, obtained by crystallisation of the brucine salt of its H phthalate, show complex rotatory dispersion. The carbinol from the (–)-H phthalate has $\alpha_{D}^{20} +2.23^\circ$, $\alpha_{438}^{20} -2.36^\circ$, $\alpha_{400}^{20} +0.56^\circ$, $\alpha_{365}^{20} +5.69^\circ$, and $\alpha_{332}^{20} +28.4^\circ$ ($l = 1$). The sp. rotations at increasing dilutions in H_2O give a family of curves of which the inflexions, max., and reversals of sign are displaced towards the ultra-violet as dilution increases. A similar family of curves is given by 5% solutions in aliphatic alcohols, the characteristic features of the curves being moved towards the longer λ as the mol. wt. of the solvent is increased. In dioxan, the sp. rotatory power in the visible spectrum is practically independent of concn. L. S. T.

Structure of hydrides of boron. III. Structure and properties of ammoniates of boron hydrides. L. E. Agronomov (*J. Gen. Chem. Russ.*, 1940, **10**, 1120—1140; cf. A., 1939, I, 599).—Structural and electronic formulae based on the tervalency of B are proposed. R. T.

Energy of aliphatic carbon linkings. E. C. Baughan and M. Polanyi (*Nature*, 1940, **146**, 685).—Linking energies for C—I, C—Br, C—H, C—Me, and C—OH in various alkyl compounds are tabulated and discussed. L. S. T.

Normal vibrations of molecules of the tetramethylmethane type. S. Silver (*J. Chem. Physics*, 1940, **8**, 919—933).—For fixed orientations of the Me groups, there are two configurations (eclipsed and staggered, respectively) in which the mol. as a whole possesses the T_d symmetry group. The group-theory analysis has been applied to the eclipsed form and, by

means of Redlich's theorem, the symmetry co-ordinates are derived. Using a simple valency potential, the secular equations for the totally symmetrical and doubly degenerate modes have been developed. Assuming the force consts. of the Me groups to be the same as in C_2H_6 , the frequencies calc. for CMe_3 , $SiMe_4$, and NMe_3 are in accord with those observed in the Raman spectra. J. W. S.

Diamagnetic anisotropy and electronic structure of aromatic molecules. H. Brooks (*J. Chem. Physics*, 1940, 8, 939—949).—Anisotropy is treated from the viewpoint of the Heitler-London-Pauling-Slater approximation by inclusion of ionic terms in the secular equation. Correlation effects tend to reduce the diamagnetic susceptibility, the effect being relatively greater in complex mols. than in C_6H_6 . The contribution of higher order permutation integrals is negligible. The variation of the anisotropy of C_6H_6 through intermediate stages of approximation is discussed by means of a more exact model. J. W. S.

Conjugated systems and "resonance." A. Burawoy (*Chem. and Ind.*, 1940, 594—596).—Vals. of the heats of combustion and hydrogenation for a no. of pairs of isomeric org. compounds show that these consts. afford no conclusive evidence for the occurrence of resonance in conjugated systems. Shortening of the C—C linking and reduction of the linking energy by adjacent multiple linkings is not confined to such systems; these effects, which show an approx. parallelism, depend on the general arrangement of linkings in the mol. and are not due to conjugation. The expected lengthening of multiple linkings by resonance is not observed. Evidence for resonance in conjugated systems based on linking energies and interat. distances is therefore invalid. A. J. E. W.

Light absorption, resonance, and electron isomerism. A. Burawoy (*Chem. and Ind.*, 1940, 855—861; cf. preceding abstract).—A review and discussion, largely of the author's work, in which absorption data for org. compounds containing conjugated linkings are shown to be inconsistent with the view that such compounds are resonance hybrids, but consistent with the existence of electron isomeric mols. in equilibrium. A. J. E. W.

Modern development of the concept of co-ordination. II. Constitution of ClO_3^- ion. G. B. Bonino (*Gazzetta*, 1940, 70, 217—227; cf. A., 1940, I, 198).—The ClO_3^- ion contains an excited Cl atom of the $3s^2 3p^3 3d^4 s$ or $3s^2 3p^3 3d^2$ type, and has a pyramidal symmetry, C_{3v} . This is supported by Raman and infra-red data. O. J. W.

Field dependence of the intrinsic domain magnetisation of a ferromagnet. T. Holstein and H. Primakoff (*Physical Rev.*, 1940, [ii], 58, 1098—1113).—Mathematical. The basis of the treatment is the exchange interaction model amplified by explicit consideration of the dipole-dipole interaction between the at. magnets. At room temp. and for fields of ~ 4000 gauss the vol. susceptibility is $\sim 10^{-4}$. Results are in satisfactory agreement with experiment. N. M. B.

Benzene formula—"resonance and mesomerism." A. G. Byard (*Chem. and Ind.*, 1940, 593—594).—Graphical methods for representing the C atom and the C_6H_6 mol. are discussed. A. J. E. W.

Coupling of molecules in liquids. A. Piekara (*Acta phys. polon.*, 1937, 6, 130—143; *Chem. Zentr.*, 1938, ii, 3657; cf. A., 1938, I, 178).—Two types of coupling force are distinguished: (a) Debye forces between neighbouring mols. in ordered arrangement; (b) association forces between mols. situated fortuitously in close proximity. In liquids having similar polarisation properties to $PhNO_2$ type (b) forces are of predominant importance. The proposed coupling mechanism prohibits a sharp distinction between associated and non-associated liquids. Calc. vals. of the reduction factor, R , are in accord with polarisation data for alcohols, $n-C_6H_{14}$ — $PhNO_2$ mixtures, and solutions of fatty acids in $n-C_6H_{14}$. A. J. E. W.

Molecular forces involved in surface formation. I. Surface energies of pure liquids. J. W. Belton and M. G. Evans (*Trans. Faraday Soc.*, 1941, 37, 1—15).—Partition functions of the liquid, surface, and vapour phases of a pure substance are used to calculate the surface free energy (γ), heat of vaporisation (L), and v.p. of the liquid. A quasi-lattice structure is assumed for the liquid, and the potential energy change on moving a mol. from the bulk to the surface is calc. for both cubical and hexagonal close-packing. For He, Ne, Ar, H_2 , O_2 ,

N_2 , Cl_2 , and CO the calc. and observed vals. of γ and of its temp. coeff. agree well, as do also, apart from O_2 and Cl_2 , the corresponding vals. of L . Calc. v.p. are of the right order of magnitude. F. L. U.

III.—CRYSTAL STRUCTURE.

Classical and quantum reflexions of X-rays in crystals. (Sir) C. V. Raman and P. Nilakantam (*Nature*, 1940, 146, 686).—A reply to criticism (cf. A., 1940, I, 348, 375). L. S. T.

Modified reflexions of Cu K α X-rays from rock-salt. G. E. M. Jauncey and O. J. Baltzer (*Physical Rev.*, 1940, [ii], 58, 1116; cf. Raman, A., 1940, I, 431).—Photographs taken when a narrow primary beam fell at various vals. of the glancing angle i on the (100) face of a thick crystal showed Bragg or B spots and Laue or L spots. A B spot lights up only for a certain val. of i , whereas when i is changed by Δ the L spots in the equatorial plane move by 2Δ . An L_{hkl} spot or a B_{hkl} spot is produced by reflexion from the hkl planes. As an $L_{h'k'}$ spot is made to approach a B_{hko} spot a modified spot appears if $h', k' = h, k$. The modified spot is therefore associated with B_{hko} and designated by mB_{hko} . Results are discussed in relation to available formulæ (cf. Zachariasen, A., 1940, I, 285). N. M. B.

Graphical method for selecting suitable targets for precision determination of cubic lattice constants and for solving cubic powder constants. L. A. Carapella (*J. Appl. Physics*, 1940, 11, 510—514).—Charts connecting the lattice parameter a_0 , λ of radiation, and diffraction angle θ of cubic lattices are given. By their use a_0 may be determined directly from θ to within 1%, and, in particular, suitable $\lambda\lambda$ for accurate determination of an approx. known a_0 may be selected. O. D. S.

Mechanical and X-ray measurement of the torsional modulus of iron. R. Glocker and O. Schaaber (*Ergebn. tech. Röntgenk.*, 1938, 6, 34—42; *Chem. Zentr.*, 1938, ii, 3656).—Measurements on a tool steel (C 0.6%) with a yield point of 35 kg. per sq. mm. are described. The X-ray and mechanical methods give 8300 ± 250 and 8140 ± 30 kg. per sq. mm., respectively, as the torsional modulus. The concordance of the two vals. shows that mechanical elasticity consts. are valid for X-ray measurements of two-dimensional stresses. A. J. E. W.

Bending and mosaic of single-crystals in the wide-angle [X-ray] diagram. H. Seemann (*Ergebn. tech. Röntgenk.*, 1938, 6, 186—209; *Chem. Zentr.*, 1938, ii, 3656).—A review of the use and advantages of wide-angle diagrams for the study of lattice defects in crystals. A. J. E. W.

Crystal structures of some heterocyclic organic compounds of analogous constitution. I. Thianthren and selenanthren. R. G. Wood and J. E. Crackston. II. Phenanthiazine, phenoxthionine, phenoxselenine, and phenoxtellurine. R. G. Wood, C. H. McCale, and G. Williams (*Phil. Mag.*, 1941, [vii], 31, 62—70, 71—80).—I. Crystallographic and X-ray measurements indicate that thianthren and selenanthren crystallise from $COMe_2$ in monoclinic holohedra, with a 14.4 and 14.5, b 6.11 and 6.24, c 11.9 and 12.1 Å., and β $110^\circ 0'$ and $110^\circ 20'$, respectively, the unit cell in each case containing 4 mols. The space-group is $P2_1/a$ (C_{2h}^2). The optical properties of the crystals are recorded and possible structures of the mols are discussed.

II. Crystallographic and X-ray measurements indicate that phenanthiazine, phenoxthionine, phenoxselenine, and phenoxtellurine crystallise from EtOH in an orthorhombic form, with a 5.91, 5.94, 5.93, and 5.97, b 7.90, 7.76, 7.85, and 8.15, and c 21.0, 20.5, 20.5, and 20.5 Å., respectively, the unit cell in each case containing 4 mols. Definite conclusions concerning the space-groups could not be drawn. The optical properties of the crystals are recorded and the possible structures of the mols. are discussed. J. W. S.

Electric fields in vibrating polar crystals. R. H. Lyddane, K. F. Herzfeld, and R. G. Sachs (*Physical Rev.*, 1940, [ii], 58, 1008—1009).—Mathematical. The polarisation P , associated with the displacements of the ions in a vibrating crystal, causes electric forces F giving rise to an electric field E and an electric displacement D . If the vibrational λ is short compared with the size of the crystal, but long compared with the lattice distance, then for longitudinal displacement, $E = -4\pi P$ and $D = 0$ (cf. A., 1939, I, 63). Calcul-

ations confirm that, for transverse vibrations, $E = 0$ and $D = 4\pi P$ (cf. Fröhlich, *ibid.*, 554). These formulae lead to the Lorentz-Lorenz force for both types of vibration; i.e., $F = E + (4\pi/3)P$. N. M. B.

Rotatory power of nickel sulphate at low temperatures. P. Rudnick, F. G. Slack, and J. O'Connor (*Physical Rev.*, 1940, [ii], 58, 1003).—Visual measurements reported for cryst. α -NiSO₄·6H₂O at $\lambda\lambda$ 4358, 5461, and 5780 at liquid air temp. agree with previous photographic measurements (cf. A., 1940, I, 350), and are compared with corresponding room temp. data (cf. A., 1938, I, 563). Natural rotations are displaced in the negative (abnormal) direction at low temp. The magnetic rotations, although in the positive (diamagnetic) direction, are increased at low temp. The Verdet const. at 5461 Å. is represented by $V = 0.018 + 2.3/T$. N. M. B.

Torsional frequencies of crystal specimens. W. F. Brown, jun. (*Physical Rev.*, 1940, [ii], 58, 998–1001).—The interpretation of twisting and bending of cylindrical specimens under a harmonically varying twisting moment is examined and results are applied to available experimental data (cf. Siegel, A., 1940, I, 250). N. M. B.

IV.—PHYSICAL PROPERTIES OF PURE SUBSTANCES.

Change of electric conductivity of water in supersonic field. S. S. Tumanski and M. S. Schulman (*Kolloid. Shurn.*, 1939, 5, 961–964).—Supersonic field produced by a piezo-quartz increases the conductivity of H₂O at 20°, e.g., by 3×10^{-4} ohm⁻¹ cm.⁻¹ within 15 min. When CO₂ passes over H₂O this increase may be 4×10^{-5} . The effect of the field is due to additional dissolution of CO₂ from the air. J. J. B.

Magnetic properties of the iron group anhydrous chlorides at low temperatures. I. Experimental. C. Starr, F. Bitter, and A. R. Kaufmann. II. Theoretical. C. Starr (*Physical Rev.*, 1940, [ii], 58, 977–983, 984–992).—I. The susceptibility χ of the anhyd. chlorides of Fe, Ni, Co, Mn, Cr, V, Ti, and Cu was studied as a function of field strength up to 32,000 gauss and of temp. down to 13.9° K. None of the compounds showed any dependence of χ on field strength at temp. $> 63^\circ$ K. NiCl₂, CoCl₂, FeCl₂, and CrCl₃, which have positive Curie temp. at room temp., show a field strength dependence of χ at 13.9° and 20.4° K. The first three have an S-type magnetisation curve characterised by a small initial χ which decreases with falling temp., followed by a very large χ and eventual approach to saturation, both increasing with falling temp. CrCl₃ (Curie point 16.8° K.) shows a field dependence of χ above and below this temp., and a large initial χ increasing with falling temp. The χ of many of the compounds reaches a max. at temp. which do not appear to be correlated with field dependence, but these temp. correspond with the temp. of known sp. heat anomalies.

II. The predictions of paramagnetic theory are compared with the room temp. results and an attempt is made to explain departures from theory in terms of the cryst. field. The low-temp. anomalies require a theory of metamagnetism. It is assumed that at temp. below the Curie point neighbouring atoms behave as groups, which are spontaneously formed at the Curie point. The at. magnetic moments within each group are assumed to be either parallel or antiparallel to each other, the latter arrangement having the lowest energy. The resulting theory satisfactorily explains the behaviour of the metamagnetic chlorides (CrCl₃, FeCl₂, CoCl₂, and NiCl₂), and qualitatively explains the behaviour of the other chlorides. N. M. B.

Effect of temperature on the ultrasonic velocity in liquids. V. Suryaprakasam (*Proc. Indian Acad. Sci.*, 1940, 12, A, 341–349).—Ultrasonic velocities (v) and adiabatic compressibilities have been measured throughout the temp. range 30–120° for C₆H₆, PrOH, CCl₄, CH₃Ph, OAc PhCl, PhBr, *o*- and *m*-C₆H₄MG·NO₂, C₆H₅Me, and cyclo-hexane and hexanone. For all these substances v diminishes with temp. at approx. 3–5 m. per sec. per degree. The rate of decrease in v for *o*- $>$ *m*-C₆H₄Me·NO₂, and for PhCl $>$ PhBr. C₆H₆ shows the greatest rate of fall and PrOH exhibits a point of inflexion at $\sim 55^\circ$. The results agree with existing data. W. R. A.

Diamagnetism of phosphorus. S. R. Rao and S. Aravamudachari (*Proc. Indian Acad. Sci.*, 1940, 12, A, 361–366).—Employing the Gouy method χ ($\times 10^{-6}$) for white P is -0.840 , and for CS₂ -0.538 . 25 solutions of P₄ in CS₂ (% com-

position $> 25\%$) have been examined. Observed χ is $>$ calc. χ for all solutions. This may be due to (a) solid white P containing complexes higher than P₄ which break down to P₄ on dissolution, or (b) the tetrahedral mol. of solid P not being completely non-polar and thus possessing intermol. interaction forces which cease to function on dissolution. Alternative (b) is preferred. W. R. A.

Low-temperature gaseous heat capacities of certain C₂ hydrocarbons. G. B. Kistiakowsky, J. R. Lacher, and W. W. Ransom (*J. Chem. Physics*, 1940, 8, 970–977; cf. A., 1939, I, 362).—The thermal conductivities of CH₂:C:CH₂, CH₂:CHMe, CH:CHMe, and cyclopropane have been measured at low pressures and at 150–340° K. by the method described previously (A., 1938, I, 184). The heat capacities deduced from these measurements are compared with those determined by other methods, and support the bracketing method of determining these vals. The heats of reaction of H₂ with C₂H₂, C₂H₄, and CH₂:CHMe at 0° K. and the non-vibrating state, calc. from measurements at higher temp., show the same regularities as the experimental vals. for 355° K., indicating that the dependence of the heat change of a reaction on other groups present in the mol. is a fundamental phenomenon, due to a change in the bonding strength within the mol. J. W. S.

Heat capacities of some organic compounds containing nitrogen, and the atomic heat of nitrogen. S. Satoh and T. Sogabe (*Bull. Inst. Phys. Chem. Res. Japan*, 1940, 19, 1348–1352).—Thermal data for org. compounds differing in mol. formula by NH₂, C₂H₂, and CH₂N₂ are reviewed, and the heat capacities of these mols. are obtained. Using the known mean at. heats of C and H, that of N can be found. The at. heat of N is usually lower in aliphatic compounds than in aromatic. The average val. is 4.46. A. J. M.

Gaseous heat capacity and restricted internal rotation of diborane. F. Stitt (*J. Chem. Physics*, 1940, 8, 981–986).—Using the low-temp. thermal-conductivity method (A., 1938, I, 184; 1939, I, 362) with C₂H₂, C₂H₄, and C₂H₆ as comparison gases, the heat capacity of gaseous B₂H₆ has been measured at 95–324° K. The val. at 95° K. ($C_p = 6.35 \pm 0.20$ g.-cal. per g.-mol. per degree) indicates that internal rotation in the B₂H₆ mol. is restricted by a potential barrier, the height of which is probably 4000–6000 g.-cal. per g.-mol. if the barrier is assumed to be a sinusoidal function of the angle of internal rotation. J. W. S.

Critical constants and van der Waals' equation. G. N. Copley (*Chem. and Ind.*, 1941, 48).—Methods of calculating van der Waals' const. b are discussed. If van der Waals' equation is valid at the crit. point, $RT_c/p_{cve} + 8p_{cve}/RT_c = h = 5.67$. Data for 31 substances give a mean h val. of 5.85, and show that h is more nearly const. than RT_c/p_{cve} . A. J. E. W.

Compressibility of ammonia at high temperatures and pressures. J. S. Kasarnovski (*Acta Physicochim. U.R.S.S.*, 1940, 12, 513–522).— P - V vals. are given for 25° intervals from 200° to 300° and for pressures 100–1629 atm. The vals. are correct to 0.5%. F. L. U.

Influence of high-frequency electric field on the velocity of crystallisation of undercooled salol. R. J. Beraga and K. K. Demidov (*Acta Physicochim. U.R.S.S.*, 1940, 12, 609–616).—In an alternating electric field of frequency 3.5 – 9×10^7 cycles per sec. the linear crystallisation velocity of salol at room temp. is reduced to an extent corresponding with a rise of temp. of 6–7°, whilst the max. rise produced by the field under the same conditions in solid or liquid salol was 2.5°. F. L. U.

Growth conditions for single and optically mosaic crystals of zinc. C. A. Cinnamon and A. B. Martin (*J. Appl. Physics*, 1940, 11, 487–490).—The conditions of growth of single crystals of Zn (99.99+ %) have been studied by a modified Kapitza method. The ratio of temp. gradient across the interfacial boundary between liquid and solid phases to the rate of growth of the crystal must be maintained within an optimum range of vals. which depends on the angle of orientation. Crystals of high orientation can be grown over a much greater range of vals. of the above ratio than those of lower orientation, and optically mosaic crystals show no preferred region of growth. A. J. M.

Viscosities of several common gases between 90° K. and room temperature. H. L. Johnstone and K. E. McCloskey

(*J. Physical Chem.*, 1940, **44**, 1038—1058).—Using the oscillating-disc method the η (relative to air at 296.1° K.) of H_2 , air, O_2 , NO , N_2O , CO_2 , and CH_4 have been determined and are recorded at ~ 10 — 15° intervals. The results, which are believed accurate to 0.3% at 300° K. and to 0.7—0.8% at the lower temp., generally agree with previously published data, but the present vals. are consistently > those of Sutherland and Maass (cf. A., 1932, 685) who used a somewhat similar apparatus. Inaccurate temp. measurement in the earlier experiments is suggested as a cause of the observed differences. C. R. H.

V.—SOLUTIONS AND MIXTURES (INCLUDING COLLOIDS).

Properties of hydrogen mixtures. A. W. Brunot (*Trans. Amer. Soc. Mech. Eng.*, 1940, **62**, 613—610).—The properties (d , sp. heat, η , and thermal conductivity) of binary mixtures of H_2 with small amounts of air, N_2 , or CO_2 are summarised. R. B. C.

Proposed standardisation of osmotic pressure as a term. W. H. Hall (*Science*, 1940, **92**, 334).—Suggestions concerning the definition of osmotic pressure are made. L. S. T.

Determination of the vapour pressure of aqueous solutions. Z. P. Tschescheva and K. N. Oseledko (*Kolloid. Shurn.*, 1939, **5**, 875—882).—Through the stopper of a flask a Ni test-tube is inserted. The flask contains the aq. solution, and the test-tube Et_2O and a thermometer. Et_2O evaporates, and the temp. at which dew appears on the tube is read. The results are consistent within 0.03 mm. Hg. Within this limit the v.p. of mol. solutions of NaCl, KCl, $CaCl_2$, $BaCl_2$, and mannitol agree with older data. The v.p. of 1M-sucrose at 25° is 23.27—23.29 mm. Hg, showing that sucrose binds 6—8 mols. of H_2O . 0.7% of starch does not affect the v.p. of salt or mannitol solutions. J. J. B.

"Re-formation" process in the study of changes of state in metals [alloys]. H. Auer and H. Schröder (*Ann. Physik*, 1940, [v], **37**, 137—154).—A detailed discussion of the physical basis of methods involving heat-treatment of alloys during the progress of changes of state. The conditions necessary for a reversal of the direction of a change by increase of temp. are outlined, and the formation, temp. hysteresis, uniformity of at. forces, and thermal energy relationships of transitional states are discussed. Deductions concerning the execution of "re-formation analyses" find complete confirmation in data for Al—Cu alloys obtained by magnetic susceptibility measurements. A. J. E. W.

X-Ray analysis of gold-aluminium alloys. O. E. Ullner (*Arkiv Kemi, Min., Geol.*, 1940, **14**, A, No. 3, 20 pp.; cf. Coffinberry *et al.*, A., 1938, I, 132).—X-Ray analysis of the Au—Al system by the powder method shows the existence of 6 intermediate phases below 500°. The α -phase is a solid solution of Al in Au, the saturation limit at 500° being approx. 12.4 at.-% of Al. The phase retains the face-centred cubic lattice of Au. The first intermediate phase, Au_4Al (the Y-phase of Heycock and Neville), exists only over a narrow range, and is obtained pure only in alloys which have been melted, allowed to cool to 400—500°, and then quenched. The lattice is simple cubic, parameter 6.902 Å. at 510°; unit cell contains 20 atoms. The co-ordination no. of the Al atom is 6. The X-ray photograph is very similar to that obtained for β -Mn, but the structure of Au_4Al is not completely identical with that of β -Mn. A δ -phase, of which the exact composition could not be determined, was also detected. The D-, E-, and X-phases of Heycock and Neville could not be obtained pure, and exist only over narrow ranges. The formulae assigned to them (Au_5Al_2 or Au_6Al_3 , Au_3Al , and $AuAl$, respectively) by Heycock and Neville are probably correct. A. J. M.

Aluminium-magnesium alloys.—See B., 1941, I, 75.

Constitution of the magnesium-rich alloys in the systems magnesium-lead, magnesium-tin, magnesium-germanium, and magnesium-silicon. G. V. Raynor (*J. Inst. Metals*, 1940, **66**, 403—426).—The systems have been examined by thermal, micrographic, and X-ray methods from the Mg end up to the eutectic. The solubility of Pb in Mg falls from 7.75 at.-% at the eutectic temp. (465°) to 5.2 at 400°, 2.3 at 300°, and 0.5 at.-% at 200°, and that of Sn in Mg from 3.35 at.-% at the eutectic temp. (560.6°) to <0.2 at.-% at 250°. Mg

dissolves ~ 0.003 at.-% of Ge and Si at 600° but both these elements are practically insol. in Mg at room temp. The eutectic points of these systems are: Pb 19.0 at.-%, 465°; Sn 10.7 at.-%, 560.6°; Ge 1.15 at.-%, 634.7°; Si 1.16 at.-%, 637.6°. The liquidus curves for the four systems form a clear valency group; other regularities between the systems are pointed out. A. R. P.

Neutron studies of order in iron-nickel alloys. F. C. Nix, H. G. Beyer, and J. R. Dunning (*Physical Rev.*, 1940, [ii], **58**, 1031—1034; cf. Whitaker, A., 1939, I, 396; 1940, I, 307).—The difference in neutron transmission between fully annealed and quenched alloys plotted against Ni content shows a broad peak near $Ni_{50}Fe$ and falls to vanishingly small vals. near 35 at.-% of Ni and pure Ni. The higher is the degree of order the greater is the transmission. Substitution of 2.3 at.-% of Mo or 4.1 at.-% of Cr for Fe in the annealed 78 at.-% Fe—Ni alloy causes a relative transmission decrease of 15.6 and 21.2%, respectively. Cold-working (known to produce disorder) of an annealed 75 at.-% Ni alloy causes a decrease of 20.6% in neutron transmission. Results demonstrate the use of neutron technique in studying order in the solid state. N. M. B.

Regular solutions of gases in liquids. M. Gonikberg (*Acta Physicochim. U.R.S.S.*, 1940, **12**, 489—500).—Hildebrand's equation (cf. A., 1935, 818) is applied to the calculation of the solubilities of H_2 and N_2 in various solvents at several temp. Approx. formulae for vals. of the internal pressure needed for the calculation are given. Henry's coeff., for low concns. and pressures, can also be deduced from the theory. F. L. U.

Solubility of gases in liquids at low temperatures and high pressures. III. Solubility of hydrogen in liquid methane. V. Fastovski and M. Gonikberg (*Acta Physicochim. U.R.S.S.*, 1940, **12**, 485—488).—The distribution of H_2 between liquid CH_4 and the vapour phase was determined at 90.3°, 110.0°, 122.0°, and 127.0° K. over the pressure range 180—230 atm., under which conditions the system behaves in accordance with Kritschewski's equation for dil. solutions. Vals. of Henry's coeff. and the partial mol. vol. of the dissolved H_2 are calc. F. L. U.

Solubility curves. E. I. Achumov (*J. Gen. Chem. Russ.*, 1940, **10**, 670—672).—Where solvates are formed it is more convenient to express concns. as g.-mols. of solvent per g.-mol. of solute. R. T.

Partition of sulphur dioxide between water and some immiscible solvent. H. Suzuki (*Bull. Inst. Phys. Chem. Res. Japan*, 1940, **19**, 1360—1363).—The distribution of SO_2 between H_2O and $CHCl_3$, C_6H_6 , and CCl_4 has been investigated at 25°. The following coeffs. were obtained: $C_{CHCl_3}/C_{H_2O} = 1.40$; $C_{C_6H_6}/C_{H_2O} = 2.03$; $C_{CCl_4}/C_{H_2O} = 0.516$. A. J. M.

Exchange of uni- and multi-valent ions in soils and glauconite.—See B., 1941, III, 30.

Sorption by clays.—See B., 1941, III, 30.

Surface activity. V. Surface activity and osmotic pressure in inorganic salts. A. Giacalone (*Gazzetta*, 1940, **70**, 274—283; cf. A., 1940, I, 203).—The surface tension γ of equiv. solutions of various chlorides is the same. The deviation of the lowering of the f.p. from the theoretical val. increases with concn. above a certain concn. This increase is the greater the higher is the valency of the cation. Increase in γ and depression of f.p. are related. O. J. W.

Surface ageing of solutions. A. E. Alexander (*Trans. Faraday Soc.*, 1941, **37**, 15—25).—The course of adsorption at the air— H_2O interface of $Ph\cdot[CH_2]_2\cdot CO_2H$ (I). $C_{12}H_{25}\cdot O\cdot SO_3Na$, $C_{16}H_{33}\cdot SO_3H$, and $C_8H_5N\cdot C_{16}H_{33}Br$ has been studied by measurements of surface and interfacial tension and of surface potential. All these substances are adsorbed at a rate \ll that calc. from their diffusion rates. The time lag is completely eliminated by the presence of a monolayer of a "piston" oil (*Et* dodecoate, oleic acid), and is considerably reduced by addition of capillary-active substances such as $PrOH$ or $EtOAc$; with (I) it is eliminated by the formation of the Na salt. The rate-determining step is considered to be the penetration and reorientation in the surface layer of the hydrophobic part of the mol. F. L. U.

Nomograph for surface tension of ethyl alcohol-water mixtures [from 15° to 90°]. D. S. Davis (*Ind. Eng. Chem.*, 1940, **32**, 1587). S. M.

Electrocapillary curves of alloys in fused salts. S. Karpatschov and A. Stromberg (*Acta Physicochim. U.R.S.S.*, 1940, 12, 523—530).—Electrocapillary curves for Sn-Zn and Mg-Tl alloys in KCl-LiCl and KI-LiI mixtures were determined at 430°. In the Tl alloys the potential corresponding with max. γ becomes more positive with increase in [Tl] up to ~20%, above which it remains const. This behaviour, which closely resembles that in aq. solutions, is attributed to adsorption of Tl at the interface with the electrolyte. Surface concns. are calc. by Gibbs' equation. F. L. U.

Study of foam stability. Effect of acids on syneresis of saponin foam. K. N. Arbuzov (*Kolloid. Shurn.*, 1939, 5, 867—874).—The foam was produced by passing air through saponin (I) solution in a sintered glass crucible. The rate of drainage of foam from solutions in H₂O is a max. when 0.4—0.5 of the foam is drained away. It is lowered by addition of HCl or AcOH when the concn. of (I) is 0.4%, and by HCl when it is 1.2%; 0.1N-AcOH reduces, and 1—2N-AcOH increases, the rate in 1.2% (I). The lowering of the rate by 0.1N-HCl is > by more conc. acids, the least lowering being observed in 1N-HCl. The rate in AcOH increases with concn. up to 2N. Presumably acids have a physical effect common to all acids, and a chemical effect different in HCl and AcOH; the relative importance of the chemical effect increases with degree of drainage. J. J. B.

Emulsions. I. Mechanism of emulsification of a standard emulsion in sodium oleate solution and nature of adsorption at the interface. II. Partial coagulation of a standard emulsion in sodium oleate solution by salts of bi- and multivalent metals. A. R. Martin and R. N. Hermann (*Trans. Faraday Soc.*, 1941, 37, 25—29, 30—38).—I. "Standard" emulsions contained 60 vol.-% of oil and were made by intermittent shaking with 0.033N-Na oleate. Some of the substances emulsified formed emulsions of the H₂O-in-oil type, and this tendency increased with increasing interfacial tension of the liquid against H₂O. Such liquids could be made to give emulsions of the oil-in-H₂O type by increasing the periods of rest between successive shakings. An explanation of this behaviour is offered. From measurements of the mean size of the droplets it is calc. that the interfacial film is in no case > unimol. In paraffin and C₆H₆ emulsions it consists of acid soap. The viscosity of emulsions of C₁₁H₂₃-OH is abnormally high.

II. The vols. of oil separated from "standard" emulsions by the addition of salts of Zn, Mg, Ca, Sr, Ba, Cu, Co^{II}, Co^{III}, Al, Th, and hexol in amounts < those required to react with the whole of the Na oleate have been measured. The effects are sp., and valency is unimportant, HCl being more effective than any of the salts used. The most important factor is the withdrawal from the stabilising film of oleic acid which is attached to the metal oleate formed. Thus CuSO₄ and Al₂(SO₄)₃, which are very effective coagulants, form oleates containing a large excess of acid, whilst ZnSO₄, which is relatively ineffective, forms a nearly normal oleate.

F. L. U.

Dependence of the law of size distribution of crystals on kinetics of crystallisation. I. Dispersion statistics for free growth. S. Roginski and O. Todes (*Acta Physicochim. U.R.S.S.*, 1940, 12, 531—558).—On the basis of kinetic equations for the free growth of crystals (cf. A., 1939, I, 616) expressions are derived for the size distribution, according to radius, surface, or vol., of primary cryst. particles. Except for the case where nucleus formation and growth are affected by decreasing concn., the distribution curves in general exhibit no max., and differ completely from those for a Gaussian distribution. The occurrence of the latter in some actual systems is due to secondary processes such as aggregation of primary particles. F. L. U.

Science of rheology. V. G. W. Harrison (*Nature*, 1940, 146, 580—582).—A review. L. S. T.

Determination of surface area of powders.—See B., 1941, I, 46.

Stabilisation of suspensions, and adsorption layers in disperse systems.—See B., 1941, II, 57.

Aluminium hydroxide sol prepared by autoclave treatment. T. Katsuragi and T. Kita (*Bull. Chem. Soc. Japan*, 1940, 15, 458—459).—A stable Al(OH)₃ sol is obtained by heating a washed suspension of the ordinary ppt. in an autoclave at 190° for 1 hr. The ppt. should be washed until free from alkali but still containing a trace of chloride. F. J. G.

Stabilisation of suspensions by adsorption layers. XX. Stabilisation of suspensions of titanium dioxide in hydrocarbon media by soaps of multivalent metals. L. R. Soloveva (*Kolloid. Shurn.*, 1939, 5, 883—897; cf. A., 1938, I, 511).—From sedimentometric curves the largest, smallest, and most probable apparent diameter (d) of 2% suspensions of TiO₂ in dry C₆H₆ are calc. to be respectively 60—80 μ , 30—60 μ , and 44—68 μ . The val. of d is reduced by 2/3 by addition to the C₆H₆ of 5% of oleic acid, or of 1% of Mg oleate, Al oleate, or Ca stearate, or of 0.1% of Ca oleate, or of 0.05% of Al stearate. No connexion with the surface activity of the soaps is observed. J. J. B.

Surface of colloidal particles in titanium dioxide sols. V. V. Kisseleva and V. A. Kargin (*Acta Physicochim. U.R.S.S.*, 1940, 12, 589—608).—Erythrosin, methylene-blue, and thionine-blue were added to dialysed sols of TiO₂ in amounts such that adsorption of the dye was complete irrespective of the sign of the charge on the colloid. The resulting changes in the absorption spectrum of the dyes are independent of the p_H of the intermicellar liquid and are determined solely by the composition of the adsorption layer. The observations are interpreted in terms of ionic exchange. F. L. U.

Base-binding capacities of hydrogen-clays.—See B., 1941, III, 30.

Electron diffraction study of hydrous oxides amorphous to X-rays. H. B. Weiser and W. O. Milligan (*J. Physical Chem.*, 1940, 44, 1081—1094).—Freshly formed gels of hydrous oxides which are amorphous to X-rays fall into two classes: those which give electron diffraction patterns characteristic of crystals, e.g., α -Fe₂O₃, γ -Al₂O₃ [from Al₂(SO₄)₃], α -Ga₂O₃, TiO₂, and probably BeO, and those which give patterns of the amorphous type, e.g., Cr₂O₃, SiO₂, Nb₂O₅, and Ta₂O₅. The gels of the first class are composed of very fine crystals which give diffuse patterns. The gels of the second class are amorphous, the atoms being arranged in a network which lacks periodicity and symmetry. C. R. H.

Study of amorphous films by electron diffraction. III. S. Yamaguchi (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1940, 38, 100—105; cf. A., 1940, I, 199).—Electron diffraction shows that a colloidal substance of definite structure, approx. cubic, appears just before a film of saturated aq. ZnBr₂ crystallises to ZnBr₂·2H₂O, and when saturated aq. ZnCl₂ crystallises. The size of these colloidal particles is 30—50 Å. A. J. M.

Time of set of silica gels. V. Effect of alcohols and p_H on the "heat of activation." L. A. Munro and J. A. Pearce (*J. Physical Chem.*, 1940, 44, 1024—1033).—Using the technique previously described (cf. A., 1937, I, 564 and subsequently), the time of set of SiO₂ gels over the range 0—50° and p_H range ~5.5—10.5 and in presence of MeOH, Pr^oOH, (CH₃)₂CHOH, glycerol, and mannitol has been determined. Those added substances which most affect the time of set are affected most by temp. changes. In alkaline media all added substances become less sp. in their effects with rise in temp.; MeOH and Pr^oOH have an accelerating action at high and a slightly retarding action at low p_H , the p_H of reversal being ~7. With all additions there is a lack of specificity at p_H ~7, suggesting that the dielectric const. of the added substance has little effect on the time of set. C. R. H.

Influence of the solvent of the formation of micelles in colloidal electrolytes. I. Electrical conductivities of sodium dodecyl sulphate in ethyl alcohol-water mixtures. A. F. H. Ward (*Proc. Roy. Soc.*, 1940, A, 176, 412—427).—In very dil. aq. solution Na dodecyl sulphate behaves as a completely dissociated electrolyte. Above a crit. concn. the equiv. conductance falls and micelles are formed. The variation of conductance with concn. was measured for a series of mixtures of H₂O and EtOH and the curves show a gradual transition from the type associated with micelle formation to that characteristic of strong electrolytes. Micelles are not formed at concn. > 40% of EtOH, and the crit. concn. at first falls and then rises with increasing addition of EtOH. The effects are interpreted by considering the radius of the micelle to be equal to the length of the paraffin chain and thus to be independent of concn. and nature of solvent. The energy changes involved in micelle formation are calc. and it is shown that the EtOH mols. are adsorbed on the micelle surfaces. G. D. P.

Systems of sodium palmitate in organic liquids. R. D. Vold, C. W. Leggett, and J. W. McBain (*J. Physical Chem.*, 1940, **44**, 1058—1071).—The solubility (s) of Na palmitate (I) in glycerol, diethylene glycol, medicinal paraffin, n -C₁₂H₂₆, PrOH, palmitic acid (II), and CCl₄ over the range 0—300° has been determined. At temp. <50° s is very low in all the solvents but at higher temp. considerable differences are observed. In general s increases with increasing polarity of the solvent, (II) and CCl₄ being the exceptions, but the formation of acid soaps with (II) and chemical reaction between (I) and CCl₄ at high temp. adequately account for their abnormal behaviour. In five of the solvents s bears no relation to the m.p. of (I), the so-called Krafft point, and this would appear to rob the Krafft point of much of its significance. s curves of (I) in H₂O, (II), and (CH₂-OH)₂ each indicate the presence of superneat soap phases of approx. equal thermal stability. These phases have possibly a micellar structure with solvent filling the interstices between soap aggregates. No phase analogous to middle soap was found. C. R. H.

Soap gels in pinene. M. Prasad and C. V. Viswanath (*Current Sci.*, 1940, **9**, 459; cf. A., 1940, I, 293).—Transparent gels formed by K oleate, Na palmitate (I), and Na stearate in pinene resemble those of Na oleate (II). The rate of syneresis of these gels is greatest with (II), least with (I). F. R. G.

Viscosity of starches of various sorts in sodium salicylate. M. I. Kniaginitschev (*Kolloid. Shurn.*, 1939, **5**, 899—906).—0.2 g. of starch is pasted with 1 c.c. of H₂O and then dissolved in 99 c.c. of 30% or 55% aq. Na salicylate. The η of solutions in 30% salicylate was at 20° 1.2—1.3 (H₂O = 1); it is almost independent of the plant (wheat, rye, barley, rice, pea, bean, potato, *Vigna sinensis*). Small granules give smaller η vals. than large granules of the same plant, presumably since small granules contain relatively more skin which is insol. in salicylate solutions. The relative η of *Solanum andigenum* is 2 although its skin is as thick as that of other kinds of potato. EtOH ppts. from these solutions a substance which gives a blue reaction with I but gives no paste with H₂O. The η of 1% starch solutions in 30% salicylate solution is 5. J. J. B.

Electric moments and relaxation times of protein molecules. J. L. Oncly (*J. Physical Chem.*, 1940, **44**, 1103—1113).—The electric moments of horse serum-albumin (I) and serum pseudo-globulin- γ (II) and of edestin (III) from hemp seed are respectively 380, 1200, and 1400 Debye units. In the case of (I) and (III) relaxation times and at. shapes calc. from dielectric dispersion data compare favourably with those calc. from ultracentrifuge, dispersion, and η measurements, but it is necessary to assume hydration to the extent of ~0.4 g. of H₂O per g. of protein in the case of (II). C. R. H.

Properties of thixotropic gels containing ovalbumin as the disperse phase. W. G. Myers and W. G. France (*J. Physical Chem.*, 1940, **44**, 1113—1126).—Theories of protein structure and of thixotropy are reviewed. The emptying time (t_E) of a viscometer containing a 1% solution of ovalbumin in presence of 30 vol.-% of AcOH, and NaCl, Na₂SO₄, or Na₂Fe(CN)₆ has been determined at 27°, and at various times (t_M) up to 1 hr. after mixing of the components. t_E increases with increase in t_M , the increase becoming more pronounced as [NaCl] increases. The systems containing 0.006—0.02N-NaCl show increasing thixotropic gel structure. If AcOH is replaced by H₂SO₄ to give the same [H⁺] t_E remains const. as t_M increases. This difference in the behaviour of a weak and a strong acid cannot be accounted for on the basis of differences in the no. of salt bridges neutralised, since in each case [H⁺] is sufficient to neutralise all the salt bridges. It is more probable that AcOH in such concn., in addition to forming albumin acetate, solvates (through H bonds) the loose ends of the salt bridges after neutralisation has allowed them to separate. These solvate mols. are in turn solvated by H₂O or by other solvated mols. until a huge lyosphere is built having a more or less extended polypeptide chain as its central strut. The interlocking of such lyospheres tends to increase η . Neutralisation of salt bridges permits the slow unwinding of the polypeptide chain which can then be solvated. Neutralisation of the salt bridges by H₂SO₄ may also result in the unwinding of the polypeptide chain, but since the amount of H₂SO₄ is small solvation of the chain has a correspondingly smaller effect. Added salts decrease the repulsion between the like-charged highly solvated particles

of the disperse phase. The salts then decrease the repulsion which normally exists between the lyospheres and cause them to cohere. Salts having multivalent ions are more effective in this than those having univalent ions. C. R. H.

VI.—KINETIC THEORY. THERMODYNAMICS.

Factors determining electrolytic dissociation. II. Free energies of dissociation of salt molecules in aqueous solution. W. J. C. Orr (*Phil. Mag.*, 1941, [vii], **31**, 51—61; cf. A., 1934, 1307).—Theoretical. Methods of calculating the total heat, entropy, and free energy changes during the dissolution of salt mols. in H₂O are derived, and applied to the calculation of these functions for KF, KCl, KBr, KI, LiCl, NaCl, RbCl, AgCl, TlCl, ZnCl₂, CdCl₂, and HgCl₂. J. W. S.

Pictures of acid-base reactions. T. H. Hazlehurst, jun. (*J. Chem. Educ.*, 1940, **17**, 374—376).—The unique behaviour of H⁺ and its marked difference from other ions in size is emphasised by using charts of "electron density" to represent mols. and ions containing H. Diagrams illustrating reactions between H₂O and HCl, NH₃, and O⁻, and between OH₃⁺ and NH₃, are reproduced. L. S. T.

Review of the interpretation of p_H . M. Gorman (*J. Chem. Educ.*, 1940, **17**, 343—345). L. S. T.

Effect of ethyl alcohol on p_H values determined by the glass electrode, and the association of ions in alcoholic hydrochloric acid. N. Yui (*Bull. Inst. Phys. Chem. Res. Japan*, 1940, **19**, 1353—1359).—The potentials of H and glass electrodes were compared by measuring the e.m.f. of the following cells at 25° (Hg₂Cl₂ in saturated KCl): H₂|HCl(aq. 0.01N.)|Hg₂Cl₂; H₂|HCl(0.01N.)|EtOH(x%)|Hg₂Cl₂; H₂|HCl(aq. 0.01N.)|glass|HCl(0.01N.)|EtOH(x%)|Hg₂Cl₂. [HCl] was maintained at 0.01N., whilst [EtOH] was increased up to 50% by wt. The difference of potential of the H electrode with increase in [EtOH] is not \propto [EtOH], and is very small, not exceeding 2.5 mv. If great accuracy is not required the glass electrode can be used satisfactorily for the determination of p_H in EtOH solutions, up to 50% concn., although results are not always reproducible. The p_H of HCl solutions increases linearly with [EtOH] up to 30%. Above this an abrupt increase in p_H was observed, which may be explained by assuming an association of Cl⁻ and H⁺. A. J. M.

Phosphatides and inorganic salts.—See A., 1941, III, 133.

Thermal dissociation of bismuth sulphide. II. I. J. Gerasimov (*J. Gen. Chem. Russ.*, 1940, **10, 1069—1072; cf. A., 1937, I, 463).—The temp.-dissociation pressure curve is given for Bi₂S₃, for the interval 650—750°. The vapour phase consists exclusively of S; lower sulphides are not found in the residue. R. T.**

Phase-rule study of the system sodium stearate-water. J. W. McBain, R. D. Vold, and (Miss) M. Frick (*J. Physical Chem.*, 1940, **44**, 1013—1024).—A phase diagram of the system Na stearate (I)—H₂O has been constructed from data obtained over the range 62—288°, and is compared with similar diagrams for Na oleate, palmitate, and laurate. The phase behaviours are comparable except at high concns. of (I). Two max. in the curve correspond with middle and superneat soap. The min. temp. of existence of isotropic liquid between middle soap and soap-boiler's neat soap and between neat soap and superneat soap are 145° and 262°, respectively. The numerous phases observed can be divided into five groups solely on the basis of the difference between the appearance at 100° and at room temp. The appearance of the curd at room temp. depends to some extent on the phase from which it is formed. C. R. H.

Phase diagrams for moist gases. A. Stradelli (*Riv. Fredde*, 1938, **24**, 293—299; *Chem. Zentr.*, 1938, ii, 3662).—A discussion of the construction and interpretation of phase diagrams for gas mixtures containing appreciable quantities of condensable constituents. A. J. E. W.

Two-phase equilibrium in binary and ternary systems. IV. Thermodynamic properties of propane. J. H. Burgoyne (*Proc. Roy. Soc.*, 1940, **A**, 176, 280—294).—Existing thermal data have been summarised and some new determinations of the p - v - T relationships for the liquid at low temp. have been made. The entropy and enthalpy have been calc. from -80° to 200° at pressures from 0.1 to 200 atm. The results are tabulated and presented graphically. G. D. P.

Liquid-vapour equilibrium in the system ammonia-methane-nitrogen at high pressures. P. E. Bolschakov and E. S. Lebedeva (*Acta Physicochim. U.R.S.S.*, 1940, 12, 501—512).—Equilibrium compositions of liquid and vapour in $\text{NH}_3\text{--CH}_4\text{--N}_2$ mixtures ($\text{N}_2:\text{CH}_4 \sim 1:4$) were determined at -20° , 0° , 25° , and 50° over the pressure range 50—560 atm. From the experimental data the solubility of pure CH_4 in liquid NH_3 is calc. The electrostatic theory of solutions (cf. Kritschewski and Chazanova, A., 1939, I, 605) is used to calculate the content of NH_3 in compressed CH_4 over the same temp. and pressure range. F. L. U.

System lime-ferrie oxide-silica. M. D. Burdick (*J. Res. Nat. Bur. Stand.*, 1940, 25, 475—488).—The equilibrium diagram for the portion of the system $\text{CaO--Fe}_2\text{O}_3\text{--SiO}_2$ containing 15—65% of CaO and $\geq 65\%$ of Fe_2O_3 has been studied. Comparison with the system $\text{CaO--Al}_2\text{O}_3\text{--SiO}_2$ shows that Fe_2O_3 extends the range of stability of the Ca silicates and lowers the liquidus and eutectic temp. Thermal analysis and X-ray investigations indicate the existence of a limited series of solid solutions of Fe_2O_3 in 2CaO.SiO_2 containing $\geq 0.5\%$ of Fe_2O_3 . No ternary compounds were detected. The application of the results to cements of high Fe_2O_3 content is discussed. J. W. S.

Equilibria in the system $\text{NaCl--PtCl}_4\text{--H}_2\text{O}$. N. S. Kurnakov and E. A. Nikitina (*J. Gen. Chem. Russ.*, 1940, 10, 577—588).—The solid phases in equilibrium with saturated solutions are $\text{PtCl}_4.5\text{H}_2\text{O}$ and $\text{Na}_2\text{PtCl}_6.6\text{H}_2\text{O}$ (I) at 40° , $\text{PtCl}_4.4\text{H}_2\text{O}$ and (I) at 60° , and $\text{PtCl}_4.3\text{H}_2\text{O}$, NaCl , and (I) at 80° , 90° , and 98° . PtCl_4 exists in two forms, yellow and red crystals. The η of solutions of the latter is anomalously high. R. T.

VII.—ELECTROCHEMISTRY.

Maximum specific conductivity. M. Usanovitch (*J. Gen. Chem. Russ.*, 1940, 10, 959—961).—Where conductance is due to formation of a dissociated complex from the components of a system, max. sp. conductivity χ is found at that concn. of the latter for which the concn. of electrolytic complex is max., in accordance with the law of mass action. In other cases χ is the resultant of the opposing effects of increasing concn. and increasing η . R. T.

Effect of apolar compounds on the conductivity of halides of aluminium in nitrobenzene and ethyl bromide. E. J. Gorenbein and I. M. Slavutzkaja (*J. Gen. Chem. Russ.*, 1940, 10, 1144—1150).—Addition of SnCl_4 , SnBr_4 , or CCl_4 depresses sp. conductivity in the systems $\text{AlBr}_3\text{--EtBr}$, $\text{AlBr}_3\text{--PhNO}_2$, and $\text{AlCl}_3\text{--PhNO}_2$. R. T.

Anomalous concentration cell. Constitution of solutions of stannous chloride in water and in hydrochloric acid. L. R. Allison, E. J. Hartung, and E. Heymann (*J. Physical Chem.*, 1940, 44, 1033—1037).—The anomalous cell $\text{Sn}^{+2}|\text{25\% SnCl}_2, 2.33\text{N-HCl}|2.5\% \text{ SnCl}_2, 0.233\text{N-HCl}|\text{Sn}^{+2}$ shows an e.m.f. of -70 mv., but with 2.33N-HCl in each cell the e.m.f. is 30.9 mv. Measurements made in absence and in presence of HCl show that the anomaly is due to the difference in $[\text{HCl}]$. With increase in $[\text{HCl}]$ there is an increase in the amount of complex ions SnCl_4 and SnCl_5^- with a corresponding reduction in the amount of Sn^{+2} , accompanied by a reduction in e.m.f. At high $[\text{HCl}]$ the complex is so stable that its degree of dissociation is only slightly affected by the total $[\text{SnCl}_2]$. The activity of Sn^{+2} which determines the e.m.f. is then approx. $\propto [\text{SnCl}_2]$. C. R. H.

Overvoltage theory of H. Eyring. A. Frumkin (*Acta Physicochim. U.R.S.S.*, 1940, 12, 481—484).—The theory (cf. A., 1940, I, 75) is criticised. F. L. U.

Electro-acoustic chemical effects. V. Reception of sound by platinum electrodes and by mercury electrodes covered with colloidal membranes. L. V. Nikitin (*J. Gen. Chem. Russ.*, 1940, 10, 636—640).—The range of wave-lengths of sound registered by a polarised Pt electrode in 0.1N-HCl increases with rising c.d. to a max., above which it again falls. Similar effects are obtained with Hg electrodes contained in semi-permeable membranes. (Cf. A., 1940, I, 414.) R. T.

VIII.—REACTIONS.

Oxidation and inflammation of gas oils.—See B., 1941, I, 58.

Heat of reaction of sulphur monochloride with methyl and ethyl alcohol. A. C. Batalin and N. A. Schtscherbakov (*J. Gen. Chem. Russ.*, 1940, 10, 730—732).—The heat of reaction of S_2Cl_2 with MeOH is 28.24555 and with EtOH 23.1622 kg.-cal. per g.-mol. The velocity coeffs. correspond with those of reactions of the first order. R. T.

Formation of carbon disulphide. H. Tominaga and M. Narita (*Bull. Inst. Phys. Chem. Res. Japan*, 1940, 19, 1370—1376).—The kinetics of the reaction between S and C have been investigated. A. J. M.

Reactivity of carbon. H. Tominaga and M. Narita (*Bull. Inst. Phys. Chem. Res. Japan*, 1940, 19, 1364—1369).—The kinetics of the oxidation of various kinds of C with different previous treatment have been studied, and the relationship between the data and the structure of the C has been examined. A. J. M.

Interpretation of the effect of diluting ozone on its action as an oxidation catalyst. E. Briner (*Arch. Sci. phys. nat.*, 1940, [v], 22, Suppl., 59—61).—The no. of mols. of O_2 activated for oxidation by a mol. of O_3 increases markedly with dilution of the O_3 in the gas (air or O_2) over the solution oxidised. This is explained by assuming that oxidation occurs in the superficial layers of the solution and depends on the law of adsorption. Data obtained previously (A., 1940, I, 297) show that Freundlich's law holds. L. S. T.

Hydrolysis of methyl acetate in relation to the activities of hydrogen ion and water in concentrated solutions of hydrochloric acid alone and in presence of chlorides. M. Duboux and A. de Sousa (*Helv. Chim. Acta*, 1940, 23, 1381—1398).—From hydrolysis measurements at 25° vals. of α and β in $\log k/m = \alpha + \beta m$ (k = velocity coeff., m = molarity of HCl) have been evaluated. In absence of chloride β is positive. In presence of chloride and with const. total $[\text{Cl}^-]$ β is negative, i.e., k increases less rapidly than m , the chloride effect increasing in the order $[\text{NH}_4\text{Cl}] < \text{NaCl} < \text{MgCl}_2$. k/a_{H^+} (a_{H^+} = H^+ activity) is reasonably const. in presence of MgCl_2 , especially when total $[\text{Cl}^-]$ is low. In presence of NaCl and NH_4Cl k/a_{H^+} decreases as m increases. The influence of the activity of H_2O ($a_{\text{H}_2\text{O}}$) can best be illustrated by finding what val. of q will give const. vals. for $k/a_{\text{H}^+} \cdot a_{\text{H}_2\text{O}}^q$. For pure HCl and for HCl--MgCl_2 mixtures $q = 7$. In similar experiments on the inversion of sucrose $q \sim 1$, but in other respects a common mechanism can be applied to both reactions. C. R. H.

Effect of copper on oxidation of vitamin-C.—See A., 1941, III, 211.

Aerogel catalysts.—See B., 1941, II, 29.

Electrodeposition of bright copper.—See B., 1941, I, 74.

Electrodeposition of indium from sulphate baths.—See B., 1941, I, 75.

Production of formaldehyde by means of the electric arc at high and low frequencies. E. Briner and H. Hæffer (*Arch. Sci. phys. nat.*, 1940, [v], 22, Suppl., 82—84).—In mixtures of $\text{CO} + \text{H}_2$ the high-frequency arc, although more effective than the low-frequency arc, gives only a relatively small yield of CH_2O . On the other hand, in presence of CH_4 the yield is much increased. Data showing the increase in yield with an increase in ν are recorded. The increased ν and the consequent reduction of pressure reduces or even suppresses entirely the deposition of C on the electrodes. L. S. T.

Wave-lengths of ultra-violet radiations capable of producing ozone and the influence of pressure on this production. E. Briner and E. Perrotet (*Helv. Chim. Acta*, 1940, 23, 1480—1490).—At ordinary pressures the most effective λ range of continuous radiation for O_3 formation is 1800—2300 Å. As the pressure is increased the optimum λ range moves to higher vals. Higher O_3 yields are obtained if the illumination is intermittent. As a result of the heat produced by the absorption of radiation O_3 decomp. proceeds concurrently with O_3 formation. Decomp. increases with increase in pressure, resulting in a reduced net yield of O_3 for a given radiation. Several theories are reviewed but the data support Wulff's mechanism, viz., decomp. of polymerised O_3 mols. which are present in low concn. at ordinary pressure. C. R. H.

Chemical effect of ultrasonic waves. S. S. Urazovskii and I. G. Polotzki (*J. Gen. Chem. Russ.*, 1940, 10, 812—818).—Exposure to ultrasonic waves has no effect on the reactions of decomp. of $\text{CCl}_3\text{CO}_2\text{H}$ in NH_2Ph , or of isomerisation of fused NH_4CNS to $\text{CS}(\text{NH}_2)_2$. R. T.

IX.—METHODS OF PREPARATION.

Reducing power of sodium hydrogen sulphite. R. N. Costeanu (*Bul. Fac. Științe Cernăuți*, 1938, 11, 269—270; *Chem. Zentr.*, 1938, ii, 3720).—0.1% aq. AgNO_3 is rapidly and quantitatively reduced to Ag by freshly prepared aq. NaHSO_3 (20 mg. per c.c.). If the aq. NaHSO_3 is kept for ~3 days the AgNO_3 is reduced to Ag and Ag_2O , and after longer keeping the reduction product is almost entirely Ag_2O ; the ppt. changes colour (yellow-red-brown-black) during the reaction, which becomes slower as the age of the NaHSO_3 solution increases. Cu, Pb, and Hg salt solutions give similar colour changes with NaHSO_3 . In all cases reduction is complete at 100° . A. J. E. W.

Electron diffraction study of the corroded state of metals. II. Corrosion of potassium, sodium, lithium, calcium, and magnesium by water. S. Yamaguchi (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1940, 38, 106—114; cf. A., 1940, I, 287).—When K is corroded by H_2O , KOH is probably first formed, but at once reacts with CO_2 forming KHCO_3 . A similar result is obtained with Na, but there is some unchanged NaOH. In the case of Li, the surface layer consists of much Li_2O with little LiOH. CO_2 plays no part in the corrosion of Li. With Ca, the corrosion film consists of CaO and Ca(OH)_2 . The film found on Mg after immersion for 10 hr. in H_2O at 20 – 25° consists of much Mg(OH)_2 with some MgO, and protects the underlying metal from further action. In H_2O containing Cl⁻ the corrosion was much more rapid, but the film was again Mg(OH)_2 and MgO. The Cl⁻ catalyses the corrosion. A. J. M.

Chromatographic filtration of alkaline solutions of copper [complexes]. O. Erämetsä (*Suomen Kem.*, 1940, 13, A, 37—38).— $[\text{Cu}(\text{NH}_3)_4]^{2+}$ and Cu-tartrate complexes are adsorbed much more strongly on filter-paper than $[\text{SnO}_2]^{2-}$ and $[\text{PbO}_2]^{2-}$. M. A. M. A.

Titanium sulphate. III. Preparation. IV. Hydrolysis. B. E. Boguslavskaja and O. M. Ottamanovskaja (*J. Gen. Chem. Russ.*, 1940, 10, 673—676, 677—682; cf. A., 1939, I, 622).—III. TiO_2 (1 part) is added to 4 parts of 50—60% H_2SO_4 at 95 – 100° , when a clear solution is obtained within 30 min. The temp. is maintained at 95 – 100° for 3 hr., when $\text{TiOSO}_4 \cdot 2\text{H}_2\text{O}$ separates in 94—98% yield.

IV. The velocity of hydrolysis of TiOSO_4 is practically unaffected by varying the $[\text{SO}_4]/[\text{TiO}_2]$ of the solution from 1.15 to 2.5, or by varying the $[\text{TiO}_2]$ from 13 to 16%. R. T.

Action of hydrogen chloride on titanate and uranic anhydrides. G. P. Lutschinski (*J. Gen. Chem. Russ.*, 1940, 10, 769—772).— TiO_2 or UO_2 and liquid HCl, or HCl at 200° , yield $\text{TiCl}_2(\text{OH})_2$ or $\text{UO}_2\text{Cl}(\text{OH})$. R. T.

Complex germanium compounds. B. N. Ivanov-Emin (*J. Gen. Chem. Russ.*, 1940, 10, 826—830).—Aq. NH_3 , paramolybdate and NH_4VO_3 were added to a solution of GeO_2 in NaOH, the solution was boiled to complete elimination of NH_3 , cooled, made acid with H_2SO_4 , and shaken with Et_2O , and the lowest of the three layers formed was collected and shaken with a small amount of H_2O . After evaporation of the Et_2O the acid $\text{H}_2[\text{Ge}(\text{MoO}_4)_3(\text{V}_2\text{O}_6)] \cdot 28\text{H}_2\text{O}$ [Rb_3 , +1.5 H_2O , Cs_3 , +1.5 H_2O , $(\text{C}_6\text{H}_5)_3\text{N}$], and guanidine salts] was obtained. R. T.

(A) Reaction of niobium pentoxide with hydrogen chloride. (B) Chlorination of niobium and its derivatives. V. I. Spitzin and N. A. Preobrashenski (*J. Gen. Chem. Russ.*, 1940, 10, 655—666, 785—798).—(A) HCl was passed over Nb_2O_5 at 600 – 700° . The fumes condense in the order Nb_2O_5 (600—400°), NbO_2Cl (300°), "white sublimate" (<300°). "White sublimate" is chiefly Nb_2O_5 with adsorbed HCl and H_2O .

(B) The following reactions are described (temp. in parentheses are those of initiation of the reactions): $2\text{Nb} + 5\text{Cl}_2 \rightarrow 2\text{NbCl}_5$ (180°); $2\text{Nb} + 8\text{HCl} \rightarrow \text{NbCl}_5 + \text{NbCl}_3 + 4\text{H}_2$ (300°); $\text{Nb}_2\text{O}_5 + 6\text{Cl}_2 \rightleftharpoons 4\text{NbOCl}_3 + 3\text{O}_2$ (400°); $\text{NbOCl}_3 + \text{Cl}_2 \rightarrow \text{NbCl}_5 + \text{O}$; $\text{Nb}_2\text{O}_5 + 6\text{Cl}_2 \rightarrow 4\text{NbOCl}_3 + 3\text{O}_2$ (350°); $\text{Nb}_2\text{O}_5 + 5\text{Cl}_2 + 5\text{C} \rightarrow 2\text{NbCl}_5 + 5\text{CO}$ (400°); $2\text{NaNbO}_3 + \text{Cl}_2 \rightarrow 2\text{NaCl} + \text{Nb}_2\text{O}_5 + \text{O}$ (700°); $2\text{NaNbO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{Nb}_2\text{O}_5 + \text{H}_2\text{O}$ (300°); $\text{Nb}_2\text{O}_5 + 6\text{HCl} \rightleftharpoons 2\text{NbOCl}_3 + 3\text{H}_2\text{O}$ (400°); $\text{Nb}_2\text{O}_5 + 6\text{HCl} \rightarrow \text{NbOCl}_3 + \text{H}_2\text{O} + \text{H}$ (300°). R. T.

Decahydrate of chromic perchlorate, and the double hydrate of chromic perchlorate and perchloric acid. V. Biber and I. Neiman (*J. Gen. Chem. Russ.*, 1940, 10, 723—729).—The salts

$\text{Cr}(\text{ClO}_4)_3 \cdot 10\text{H}_2\text{O}$, $\text{Cr}_2\text{H}(\text{ClO}_4)_7 \cdot 21\text{H}_2\text{O}$, and $\text{Cr}(\text{ClO}_4)_3 \cdot 9\text{H}_2\text{O}$ are prepared and described. The following co-ordination formulae are assigned, from consideration of ionisation data: $[\text{Cr}(\text{H}_2\text{O})_6(\text{OH}_2, \text{H}_2\text{O}_2)] [\text{ClO}_4(\text{H}_2\text{O})]_3$, $[\text{Cr}(\text{H}_2\text{O})_5\text{ClO}_4, \text{Cr}(\text{OH}_2)_4, \text{ClO}_4, \text{H}_2\text{O}_2] [\text{ClO}_4(\text{H}_2\text{O})]_2$, and $[\text{Cr}(\text{ClO}_4)_2(\text{H}_2\text{O})_6] [\text{ClO}_4(\text{H}_2\text{O})]_2$. R. T.

Highly substituted sodium salts of phosphotungstic acid. E. A. Nikitina (*J. Gen. Chem. Russ.*, 1940, 10, 779—784).—The Na_4 , Na_5 , Na_6 , and Na_7 salts of $\text{H}_7[\text{P}(\text{W}_2\text{O}_7)_6]$ have been prepared and described. R. T.

Action of iodine on potassium ferricyanide solution. A. A. Bombelli (*Anal. Assoc. Quim. Argentina*, 1940, 28, 123—128).—I with a solution of $\text{K}_3\text{Fe}(\text{CN})_6$ yields $[\text{Fe}(\text{CN})_6]_3$, CNI , and CN^- with intermediate formation of $\text{Fe}(\text{CN})_6^{4-}$. F. R. G.

X.—ANALYSIS.

Determination of hydrogen-ion concentration. Anon. (*Engineering*, 1941, 151, 21—23, 64—65).—A review of modern methods and apparatus.

Determination of purity of steam.—See B., 1941, I, 45, 46.

Micro-manometric determination of sulphate and phosphate.—See A., 1941, III, 236.

Nitrosolignin colorimetric test for [determining] sulphite [pulp] waste liquor in sea-water.—See B., 1941, III, 59.

Joint determination of nitrogen, hydrogen, carbon monoxide, carbon dioxide, methane, ethylene, and acetylene.—See B., 1941, I, 63.

Determination of ammonia in condensed steam.—See B., 1941, I, 46.

Iodometric determination of alkali: investigation of G. S. Smith's method. J. Haslam and R. F. Roberts (*Analyst*, 1940, 65, 399—403).—Smith's method (A., 1937, I, 531) gives low vals. because the IO_3^- and I^- are not present in the reaction product in the theoretical proportions. By determining the total I present after the removal of excess of I by a modification of Kolthoff and Yutzy's method (A., 1937, I, 197) satisfactory vals. were obtained. The modified method is useful for the determination of alkali in dark-coloured deposits and sludges and in washing mixtures containing added dye where titration with the use of indicators is not practicable. E. C. B. S.

Determination of alkalis in feldspars.—See B., 1941, I, 63.

Micro-manometric determination of magnesium.—See A., 1941, III, 152.

Determination of copper.—See A., 1941, I, 92.

Determination of copper in high-duty cast iron containing molybdenum.—See B., 1941, I, 71.

Colorimetric determination of copper in food products.—See B., 1941, III, 50.

Determination of mercury in complex ions [in pharmaceutical preparations].—See B., 1941, III, 55.

Determination of mercury in mercurochrome.—See B., 1941, III, 55.

Effect of p_{H} on the precipitation of indium with hydrogen sulphide. O. Erämetsä (*Suomen Kem.*, 1940, 13, A, 29—30).—The apparent wide variation in p_{H} vals. at which In_2S_3 is pptd. is due to preliminary formation of colloidal In_2S_3 , which is invisible until coagulated. M. H. M. A.

Separation of indium from tin by means of sodium hydroxide. O. Erämetsä (*Suomen Kem.*, 1940, 13, B, 17—18).— $\text{In}(\text{OH})_3$ pptd. from 2N-NaOH solutions of In-Sn mixtures by heating at 60° contained about 1% $\text{Sn}(\text{OH})_2$, which was not diminished by repeating the process. The residual Na_2SnO_2 solution contained only 0.001% In. M. H. M. A.

Determination of iron in aluminium etc. with 8-hydroxyquinoline.—See B., 1941, I, 75.

Identification of small quantities of vanadium. Sensitivity of the method of Montequi and Gallego. J. M. Bach (*Anal. Assoc. Quim. Argentina*, 1940, 28, 108—110).—If the complex of 8-hydroxyquinoline and V formed in the Montequi-Gallego reaction (A., 1935, 464) is extracted with isoamyl alcohol

instead of CHCl_3 , the sensitivity is increased to permit the detection of 5.6 μg . of V per 100 ml. or 0.084 μg . per ml.

F. R. G.

Determination of vanadium in water. J. M. Bach and R. A. Trelles (*Anal. Asoc. Quim. Argentina*, 1940, 28, 111—122).—The qual. method of Bach (preceding abstract) can be used for the colorimetric determination of V if Fe is previously removed by aq. NH_3 . Excess of org. matter must be removed by boiling with HNO_3 , free acid being neutralised with NH_3 . The intensity of colour for 0.10—0.50 mg. of V per l. follows Beer's law. The method is not invalidated by <0.2 mg. of Cu per l., whilst Ti can be eliminated by NaF.

F. R. G.

XI.—APPARATUS ETC.

Calibration of thermocouples at low temperatures. R. B. Scott (*J. Res. Nat. Bur. Stand.*, 1940, 25, 459—474).—A cryostat for use at 0° to -170° comprises two coaxial Dewar vessels, the outer vessel containing liquid air or liquid O_2 , whilst the refrigerating effect is varied by changing the air pressure between the walls of the inner Dewar vessel. The latter contains a heating coil and Pt resistance thermometer thermoregulator, immersed in the cryostat liquid ($\text{CCl}_4 + \text{CHCl}_3$, $\text{CHCl}_3 + \text{CH}_2\text{Cl}_2$ + EtBr + *trans*- $\text{C}_2\text{H}_2\text{Cl}_2 + \text{C}_2\text{HCl}_2$, or C_2H_6 , according to the temp. required). Temp.-e.m.f. relations for a Cu-constantan thermocouple are given in tables. Deviation curves for a no. of these thermocouples indicate that fairly good calibration may be effected by means of the CO_2 sublimation temp. (-78.51°) and the b.p. of O_2 (-182.97°). Methods of determining these points are described.

J. W. S.

Quantitative spark-spectrography of solutions. W. D. Treadwell and R. Walti (*Helv. Chim. Acta*, 1940, 23, 1440—1456).—A simple apparatus for the sparking of solutions of metal sulphates with pure C electrodes is described. The determination of one metal (A) in presence of a large amount of another metal (B) is possible by measuring the relative intensities (I) of the spectral lines from each metal. The slope of the straight line obtained by plotting $\log I_B/I_A$ against $\log \text{concn. of A}$ is characteristic of A. The slopes obtained when B = Al and A = Mg, Mn, Cu, Fe, Ni, and Si have been determined and successfully applied to the determination of these elements in Al alloys.

C. R. H.

Technical requirements in the determination of absorption spectra by the ultra-violet microscope. P. A. Cole and F. S. Brackett (*Rev. Sci. Instr.*, 1940, 11, 419—427).—The requirements on the monochromatic illuminating system determined by the spectral properties of the source and the optical properties of the microscope are analysed and tabulated. An improved method of quant. densitometry is described.

D. F. R.

Improved high-speed recording spectrophotometer. G. R. Harrison and E. P. Bentley (*J. Opt. Soc. Amer.*, 1940, 30, 290—294).—With the instrument described density or transmission curves for the λ range 3400—9800 Å. are traced automatically on a linear λ scale, with an accuracy of $\sim 1\%$ in 70 sec.; with a high-pressure Hg arc as light source the range 2300—3400 Å. can also be covered in a few min. A spectral band 0.5—10 Å. in width is obtained from a 10-ft. concave-grating monochromator with fixed slits, and the intensity of the beam after passing through the specimen is balanced against that of the same beam after traversing a photometric disc. The balancing and recording processes are effected ~ 20 times per sec. by an 11-stage electron multiplier and an electric "memory" device. Typical curves for transformer oils are shown.

A. J. E. W.

Correlation method for elimination of errors due to unstable excitation conditions in quantitative spectrum analysis. S. Levy (*J. Appl. Physics*, 1940, 11, 480—487).—Difficulties in spectrochemical analysis arise chiefly from variability of the light source, but the radiation of all sources is determined by either the gas temp. or the electron temp. The excitation energy is therefore distributed among the excited states of the atoms statistically, the no. of atoms in the various energy levels being determined uniquely by the electron or gas temp. The intensity ratio of two lines is thus related to the intensity ratio of two others. These considerations form the basis of a correlation method by which the effect of change of electric parameters, shape of electrodes, or distance between them,

etc., is eliminated. Measurements are made on two pairs of lines, the working pair and the fixation pair, the former consisting of one line from the main substance and one from the impurity, and the latter of two lines from the main substance which react differently when one of the excitation conditions is changed. The correlation between the intensity ratios of the two pairs can be found by deliberately altering one of the conditions. A reduction curve is obtained, by the aid of which the concn. of impurity is determined. The method may also be used under standard conditions to improve accuracy.

A. J. M.

Spectrophotometers.—See B., 1941, I, 47.

Rapid-operating colorimeter.—See B., 1941, I, 47.

Quantitative capillary luminescence analysis. F. E. E. Germann and J. W. Hensley (*J. Physical Chem.*, 1940, 44, 1071—1081).—Using a direct vision fluorometer the possibility of determining the concn. of various fluorescent substances in org. solvents by measuring the fluorescence intensity along filter-paper strips dipped in the solutions has been investigated. The most reliable measure of concn. is the total fluorescence energy along the strip rather than the width or the height above the liquid of the strongest fluorescence band. The concns. investigated ranged from 0.003 to 0.8% according to the solute and solvent. At high concns. the formation of large crystals lowers the accuracy of the method since fluorescence energy is then not \propto concn.

C. R. H.

Polarimeter [analyser] with penumbra. E. Perucca (*Nuovo Cim.*, 1940, 17, 1—4).—A cheap and sensitive apparatus which can be used with any light source, even monochromatic, is described. With a monochromatic point source the apparatus is more sensitive than that of Lippich.

O. J. W.

Sterilamp [mercury arc lamp].—See B., 1941, I, 47.

Multi-purpose photo-electric reflectometer. R. S. Hunter (*J. Res. Nat. Bur. Stand.*, 1940, 25, 581—618).—In the reflectometer two separate beams from a single source are directed to two carefully matched barrier-layer photo-cells. One beam is reflected specularly from one specimen, whilst the other is reflected diffusely from the other specimen before incidence on the photo-cells. The distance of one photo-cell can be adjusted along a calibrated scale until a galvanometer indicates that the cells generate equal currents. In measurements one beam is used as comparison beam and the other as the test beam. Various applications of the instrument are discussed.

J. W. S.

Mounting "global" for researches in the infra-red. A. Levialdi (*Rev. Sci. Instr.*, 1940, 11, 429).—The carborundum rod (diameter 1 cm.) is surrounded by a mirror in the form of a coaxial cylinder (diameter 4 cm.) 6 cm. long with a longitudinal slit 1.2 cm. broad. The required high temp. is thus obtained over the comparatively short length of rod within the mirror.

D. F. R.

Increasing the life of Nernst glowers. E. S. Ebers and H. H. Nielsen (*Rev. Sci. Instr.*, 1940, 11, 429—430).—The usual Pt terminal is replaced by a Pt globule, melted down from 8 in. of No. 30 wire and welded to the filament. The radiation from the globule is sufficient to keep it from melting.

D. F. R.

Anomalies in mass-spectrography. H. Lichtblau (*Anz. Akad. Wiss. Wien, math.-nat. Kl.*, 1938, 23—24; *Chem. Zentr.*, 1938, ii, 3719).—The occurrence of "ghosts," bands, and line broadening in spectra obtained with mass-spectrographs of the Mattauch type is explained.

A. J. E. W.

A.c.-operated d.c. amplifier with large current output. S. N. Treviño and F. Oñfer (*Rev. Sci. Instr.*, 1940, 11, 412—415).—A d.c. phase inverter using cathode in phase degeneration drives the push-pull output stage. The output is linear over a range of 160 ma.

D. F. R.

Shielded glass electrode. J. Adler (*Science*, 1940, 92, 385—386).—The aq. KCl, which ends in a fluid junction and completely surrounds the stem of the electrode and the lead to the measuring apparatus, forms the shield.

L. S. T.

Calibration of Neher-Harper counter circuit for accurate comparison of β - or γ -ray sources. D. E. Hull (*Rev. Sci. Instr.*, 1940, 11, 404—411).—Accurate control of the plate voltage and grid bias of the quenching valve is essential for reproducible results, and a method of maintaining them to

within 0.01 and 0.2%, respectively, is described. At counting rates >100 per sec. an upward drift in the rate is observed, but this error, $\sim 5\%$, may be reduced by "warming up" the counter at a rate \leq that used in the measurement and then measuring the various sources in order of decreasing counting rate. A new method of calibration, using a sample of Rn, is described. Rates of 30–200 per sec. may be measured with an accuracy of 0.2–0.3%. D. F. R.

Double-acceleration high-voltage electron gun. H. Moss (*J. Sci. Instr.*, 1941, 18, 8–9).—In the electron gun described, the electrons are generated in a low-voltage, cold-cathode tube, and are accelerated in a relatively high vac. The apparatus is suitable for generating an electron beam of 40–100 kv. energy at beam currents of a few μ a. A suitable self-contained high-voltage exciter unit, with protective devices, is also described. The apparatus has the advantage over other types of electron gun of producing a relatively const. electron beam, and in the fact that all pumps are maintained at earth potential. A. J. M.

Device for accurate delivery of small amounts of fluid. J. Vondrak (*Science*, 1940, 92, 410).—A spring clip is attached to the barrel and plunger of a syringe and controls the amount of fluid delivered. L. S. T.

Optimal dimensions of a Clusius–Dickel isotope separator. W. Krasny–Ergen (*Physical Rev.*, 1940, [ii], 58, 1078–1085).—A treatment of the theory of Furry (cf. A., 1939, I, 395) concerning the choice of dimensions of a single-stage apparatus to obtain a given concn. of isotope, small compared with unity, at a min. operating cost. Formulae for distance between the tubes, mean circumference of the annular space between them, length of tubes, and min. cost are deduced, and the problem is extended to an "ideal" multi-stage apparatus. Data are illustrated numerically for production of ^{13}C . N. M. B.

Electrically driven magnetically supported vacuum type ultracentrifuge. C. Skarstrom and J. W. Beams (*Rev. Sci. Instr.*, 1940, 11, 398–403; cf. A., 1939, I, 224).—Rotation is effected through a transitor oscillator and amplifier operating a two-phase salient pole stator and solid steel armature, producing at 1188 cycles per sec. and 1 kw. motor input a torque of 600 g.-sec. throughout the starting period up to 10% slip. The $\frac{7}{8}$ -lb. rotor is supported magnetically and may be accelerated to 60,000 r.p.m. in 18 min. On reaching the desired speed a slip speed control actuated by a coaxial magnetic pickup sharply reduces the power input and holds the speed const. to within 0.05%. D. F. R.

Gas detection apparatus for qualitative microchemistry. C. L. Wilson (*Analyst*, 1940, 65, 407–408).—The test chamber of the apparatus contains a series of test filter-paper discs. When two gases are released the first is removed by the first few filter discs whilst the second is detected by its reaction on the later test discs. The apparatus has been used successfully for the detection of AsH_3 and SbH_3 in presence of H_2S . E. C. B. S.

Systematic qualitative organic micro-analysis. Determinations of specific gravity.—See A., 1941, II, 79.

Fluorescent medium for use on surface plates. H. D. Griffith and A. M. Fraser (*J. Sci. Instr.*, 1941, 18, 9–10).—A suspension of powdered anthracene in medicinal paraffin is spread on the surface plate and the work pressed on it. The high spots, where the anthracene has been picked up, are rendered visible with an ultra-violet lamp, as intensely green fluorescent patches. The contrast is \gg with the Prussian-blue technique. A. J. M.

Cryolite films on glass surfaces. J. W. French (*Nature*, 1940, 146, 687).—The explanation of the increased transmission of light resulting from the cryolite treatment of optical surfaces is discussed. L. S. T.

pH nomograph for industrial alkalis.—See B., 1941, I, 62.

Materials for preparation of vertebrate fossils. Analysis of their effectiveness. H. A. Lepper, jun., and G. E. Lewis (*Amer. J. Sci.*, 1941, 239, 17–24).—Tests of plaster of Paris beams impregnated with various binders, made to evaluate the relative merits of these materials as strengthening agents for the prep. of vertebrate fossil specimens, are recorded. Gum arabic weakens the plaster specimens, and Duco cement gives a slight increase in strength but covers the specimens

with a tough film. Shellac, Egyptian cement, Alvar, and Catalin, in the order given, improve strength. The relative advantages of these materials with regard to cost, colour, and ease of use are also discussed. L. S. T.

XIII.—GEOCHEMISTRY.

Copper, lead, and zinc content of the hot springs of Japan. [Determination of copper.] K. Kuroda (*Bull. Chem. Soc. Japan*, 1940, 15, 439–441).—For the determination of Cu in mineral H_2O the sample (500 c.c.) is boiled with HNO_3 to oxidise the Fe, which is then pptd. by the addition of excess of NH_3 and $(\text{NH}_4)_2\text{CO}_3$. After redissolution and repptn. of the Fe, the combined filtrates are acidified with HNO_3 and evaporated to dryness. The residue is dissolved in HNO_3 , adjusted to pH 3, and titrated with a CCl_4 solution of dithizone. Ag is extracted from the CCl_4 until this layer turns from orange-yellow to reddish-violet, and the vol. of reagent required between this colour change and the change to a permanent green is determined and gives a measure of the [Cu]. Various Japanese springs contain Cu 0.06–68, Pb 0.000–0.033, and Zn 0.008–0.027 mg. per l. J. W. S.

Titanium. XVI. Transition of anatase into rutile structure. A. V. Pamfilov and E. G. Ivantscheva (*J. Gen. Chem. Russ.*, 1940, 10, 736–744).—Transition of anatase to rutile structure of TiO_2 takes place at 800–900°. The process is retarded by TiOSO_4 and other impurities. R. T.

Metamorphic, ore-bearing, radioactive rocks from Feldbach (Binnen valley). E. Hugli and H. Hirschi (*Schweiz. min. petr. Mitt.*, 1938, 18, 12–39; *Chem. Zentr.*, 1938, ii, 3670).—Micaceous rocks containing haloes due to radioactivity are described. A. J. E. W.

Potassium-rich alkali rocks from Bulgaria. Eruptive rocks from Svidnja (western Balkans). S. Dimitrow (*Ann. Univ. Sofia, Fac. phys.-math., III, Sci. nat.*, 1937, 33, 291–344; *Chem. Zentr.*, 1938, ii, 3669).—Occurrences of shonkinites, K-quartz syenite, and quartz tinguaites are described. A. J. E. W.

Geological-petrological study of the Grand Combin zone of the Val d'Illemon (Aosta Province, Italy). E. A. Diehl (*Schweiz. min. petr. Mitt.*, 1938, 18, 214–403; *Chem. Zentr.*, 1938, ii, 3669). A. J. E. W.

Geological-petrological studies in the lower Valpellina, Aosta Province (Italy). R. Masson (*Schweiz. min. petr. Mitt.*, 1938, 18, 54–213; *Chem. Zentr.*, 1938, ii, 3669).—Analyses of the deposits are included. A. J. E. W.

Willemite morphology and paragenesis at Balmat, N.Y. F. H. Pough (*Amer. Min.*, 1940, 25, 488–496).—The occurrence and morphology of supergene willemite (I) of the St. Joseph Lead Company mine at Balmat are described. Paragenesis is discussed. The (I) is of high purity and non-fluorescent. L. S. T.

Distinction between calcite and dolomite on polished surfaces. J. Rodgers (*Amer. J. Sci.*, 1940, 238, 788–798).—A crit. examination of existing methods shows that staining of calcite by means of aq. $\text{Cu}(\text{NO}_3)_2$ followed by fixation with aq. NH_3 is the most satisfactory. A standard procedure is detailed. L. S. T.

Optical properties and chemical composition of two micas from Westland, South Island, New Zealand. C. O. Hutton (*New Zealand J. Sci. Tech.*, 1940, 21, 330–331b).—Chemical analyses [F. T. Seelye] of muscovite (I) from Duffer Creek, and Cr-bearing (0.27% Cr_2O_3) muscovite (II) from Whitcombe Valley, are recorded. (I) has α 1.5690 \pm 0.0002, β 1.5932, γ 1.5976, ρ_{20} 2.819, and (II), α 1.5690 \pm 0.0002, β 1.5930, γ 1.5973, ρ_{20} 2.821. The analyses agree with the formula $\text{KX}_2\text{Y}_2\text{O}_{10}(\text{OH},\text{F})_2$, where X represents cations of co-ordination no. 6, and Y cations of co-ordination no. 5. L. S. T.

What do "traces of oil" indicate? M. Ongley (*New Zealand J. Sci. Tech.*, 1940, 21, 332b).—The danger of concluding erroneously that a trace or seepage of oil indicates the proximity of an oilfield is pointed out and discussed. L. S. T.

Geology of British oilfields. I. Geology of the Assam–Arakan oil region (India and Burma). H. M. Sale and P. Evans (*Geol. Mag.*, 1940, 77, 337–363).—The development of the oil industry, occurrences of oil and gas, and the stratigraphy of the rocks are described. L. S. T.

BRITISH CHEMICAL AND PHYSIOLOGICAL ABSTRACTS

A., I.—General, Physical, and Inorganic Chemistry

APRIL, 1941.

I.—SUB-ATOMICS.

Paschen-Back effect. VII. Configuration interaction. J. B. Green (*Physical Rev.*, 1941, [iii], 59, 69—71; cf. A., 1939, I, 501).—The spectrum of Kr exemplifies well the effect of configuration interaction. The levels $3s_z$ and $4d_z$, belonging to configurations of the same parity, are $<1\text{ cm}^{-1}$ apart, and the Zeeman patterns of lines arising from them show large perturbations as regards both positions and relative intensities of the components. A semi-empirical theory leading to good agreement with experiment is discussed. N. M. B.

Zeeman effect of xenon. J. B. Green, E. H. Hurlburt, and D. W. Bowman (*Physical Rev.*, 1941, [ii], 59, 72—74).—Full Zeeman data for $\sim 125\text{ Xe I}$ lines are tabulated. The g sum rule is violated by both of the completely known configurations, and in some cases may be accounted for by configuration interaction. N. M. B.

Photoconductivity of a natural willemite crystal. R. C. Herman and R. Hofstadter (*Physical Rev.*, 1941, [ii], 59, 79—84; cf. A., 1939, I, 60; 1940, I, 311).—Data for the dependence of the photoconductivity on the λ of the exciting light, temp., and time are plotted and discussed. The ultra-violet absorption spectrum of the crystal has been obtained. N. M. B.

Work function and temperature. S. Seely (*Physical Rev.*, 1941, [ii], 59, 75—78).—The change in height of the potential energy barrier at the surface of a metal with the expansion of the metal on heating is investigated, and the change of the normal max. energy of an electron in a metal is calc. as a function of temp. of the metal. Results show that the work function is a linear function of temp., and, with the thermionic emission equation, show that the thermionic emission const. is characteristic of the metal, and is no longer the same for all pure metals. Calc. consts. for C, Ca, Mo, Ni, Pt, and W show fair agreement with experiment. N. M. B.

Stationary electric and magnetic fields in beams of light. F. Ehrenhaft (*Nature*, 1941, 147, 25).—Experimental results show that every wave of light possesses a stationary field intensity in its direction of propagation, and also a stationary magnetic field. There is thus a p.d. between two points on the ray of light which has magnetising effects. L. S. T.

Abundance ratio $^{61}\text{Ni} : ^{64}\text{Ni}$. H. A. Straus (*Physical Rev.*, 1941, [ii], 59, 102—103).—In view of discordant available data, a new double-focussing mass spectrograph was used to separate the ions. The ratio obtained is 1.3. N. M. B.

Isotopic weights of nickel isotopes by the doublet method. T. Okuda, K. Ogata, H. Kuroda, S. Shima, and S. Shindo (*Physical Rev.*, 1941, [ii], 59, 104).—From mass differences obtained from doublet photographs, using a discharge through the vapour mixture $\text{Ni}(\text{CO})_4\text{-n-C}_2\text{H}_{10}$, the following isotopic wts. and packing fractions, respectively, were obtained: ^{58}Ni $57.95967 \pm 4.1 \times 10^{-4}$, -6.97 ± 0.07 ; ^{60}Ni $59.94977 \pm 3.5 \times 10^{-4}$, -8.37 ± 0.06 ; ^{61}Ni $60.9540 \pm 15 \times 10^{-4}$, -7.5 ± 0.7 ; ^{62}Ni $61.94955 \pm 3.9 \times 10^{-4}$, -8.14 ± 0.06 ; ^{64}Ni $63.94740 \pm 5.6 \times 10^{-4}$, -8.22 ± 0.09 . The calc. at. wt. is 58.69, in exact agreement with the international val. N. M. B.

Radioactivity and the periodic table. J. F. King and P. H. Fall (*J. Chem. Educ.*, 1940, 17, 481—482).—A demonstration model is described and illustrated. L. S. T.

Neutro-electric effect. S. Kikuchi and H. Aoki (*Proc. phys.-math. Soc. Japan*, 1938, [iii], 20, 403—404; *Chem. Zentr.*, 1938, ii, 3783).—The effective cross-section of the Pb 93

atom for the neutro-electric effect is $0.5 - 1 \times 10^{-25}\text{ sq. cm.}$ This val. accounts for the unexpectedly small no. of paired tracks obtained in Wilson chamber photographs (cf. A., 1938, I, 169, 289; 1939, I, 56). A. J. E. W.

Collisions of neutrons with deuterons and the nature of nuclear forces. H. S. W. Massey and R. A. Buckingham (*Nature*, 1940, 146, 776).—The angular distribution of 1.85-MeV. neutrons scattered by deuterons has been calc. for three assumed types of force, viz., (i) "mixed" exchange force, (ii) Majorana-Heisenberg exchange force, and (iii) "ordinary" force. Comparison with experimental results favours (i) or (ii), whilst evidence from the total collision area supports (i) strongly. Fundamental nuclear forces thus appear to be of type (i). L. S. T.

Scattering of α -particles in helium. J. A. Wheeler (*Physical Rev.*, 1941, [ii], 59, 16—26).—Mathematical. Deviations from the scattering expected from an inverse square law of force between α -particles are interpreted satisfactorily in terms of the influence on particles of 0, 2, and 4 units of angular momentum of a sp. nuclear interaction having a range $<9 \times 10^{-13}\text{ cm.}$ The semistable state of the compound nucleus ^8Be found in certain disintegration experiments is found from the scattering analysis to have an energy $\sim 3\text{ Me.v.}$, a mean life of $0.8 \times 10^{-21}\text{ sec.}$, and zero angular momentum. There is evidence for a semistable state of still shorter life, angular momentum 2, and energy 4—5 Me.v. N. M. B.

α -Particle model and the properties of the nucleus ^8Be . J. A. Wheeler (*Physical Rev.*, 1941, [ii], 59, 27—36).—Reasons are given for renouncing any attempt to interpret the scattering of α -particles in He in terms of a hypothetical law of force between α -particles. Available data and scattering analysis (cf. preceding abstract) lead to the following vals. for energy, width, life, and angular momentum, respectively, of ^8Be : normal state, 125 ke.v., $1-100\text{ e.v.}$, $10^{-16}-10^{-17}\text{ sec.}$, 0; first excited level, 2.8 Me.v., 0.8 Me.v., 10^{-21} sec. , 0; second excited level, —, very great, —. 2 Difficulties remain in the interpretation of the reaction of ^{11}B with protons to yield ^8Be . N. M. B.

Interaction of α -particles. H. Margenau (*Physical Rev.*, 1941, [ii], 59, 37—47; cf. Hafstad, A., 1939, I, 6).—Mathematical. An examination, on the basis of a Heitler-London analysis, of the forces between α -particles tends to discredit the α -particle model of the nucleus and to destroy the supposition that the forces are describable as a superposition of repulsive first-order and attractive second-order effects, or that the forces are additive. The range of the forces is approx. that of the forces between elementary nuclear particles. Results are applied to the problem of the scattering of α -particles in He. N. M. B.

Production of ^3He . R. D. Hill (*Physical Rev.*, 1941, [ii], 59, 103; cf. Alvarez, A., 1939, I, 590).—Assuming that the presence of ^3He in the atm. is due to transmutations involving cosmic rays, with the ^6Li slow-neutron reaction the most probable, the calc. no. of ^3He atoms in the air is $\sim 4 \times 10^{21}$. N. M. B.

Capture cross-section for C neutrons. R. D. O'Neal and M. Goldhaber (*Physical Rev.*, 1941, [ii], 59, 102).—Data obtained by the method of induced radioactivity are tabulated for N, F, Na, Mg, Al, Si, P, Cl, K, Ca, Ni, Cu, Ga, Sb, Tl, and Bi, and results are compared with available data. N. M. B.

Positrons from light nuclei. M. G. White, E. C. Creutz, L. A. Delsasso, and R. R. Wilson (*Physical Rev.*, 1941, [ii], 59, 63—68; cf. A., 1939, I, 592).—Four nuclei containing

one more proton than neutron (cf. Wigner, *ibid.*, 595) have been produced. Their half-lives and positron energies are: ^{30}P , 4.6 sec., 3.63 Me.v.; ^{31}S , 3.2 sec., 3.85 Me.v.; ^{33}Cl , 2.4 sec., 4.13 Me.v.; ^{35}A , 2.2 sec., 4.38 Me.v. Energies agree with calc. vals. and indicate that the π - π force exceeds the ν - ν force only by the Coulomb repulsion, nuclear vols. \propto at. wts., and nuclear charge is distributed uniformly through the vol. The half-life-energy relation agrees with the Fermi theory, with deviations as anticipated by the Gamow-Teller modification. N. M. B.

Branching ratios in the fission of uranium (235). H. L. Anderson, E. Fermi, and A. V. Grosse (*Physical Rev.*, 1941, [ii], 59, 52—56).—With a view to determining the probability (branching ratio) that when U fission occurs a given radioactive series will appear, a survey is reported of the % of slow neutron-induced U fissions that give rise to various series. The vals. found, 0.1—10%, were obtained by measuring the no. of β -disintegrations of a suitable member of the series after an irradiation under specified geometrical conditions and a quant. chemical separation. N. M. B.

Photo-fission of uranium and thorium. R. O. Haxby, W. E. Shoupp, W. E. Stephens, and W. H. Wells (*Physical Rev.*, 1941, [ii], 59, 57—62).—A full report of the discovery of photo-fission by γ -rays (cf. A., 1940, I, 341). The measured cross-section for the photo-fission of U and Th by γ -rays from F bombarded with protons is $3.5 \pm 1.0 \times 10^{-27}$ and $1.7 \pm 0.5 \times 10^{-27}$ sq. cm., respectively. N. M. B.

Equation of $^{235}\text{uranium}$ fission. A. V. Grosse (*J. Amer. Chem. Soc.*, 1940, 62, 3524—3525).—The fission products from ^{235}U can be classed in two groups, a heavy group containing elements of at. wt. 125—150 and a light group of elements having at. wt. 80—100. A provisional, but incomplete, "fission equation" for the amounts of various elements produced when 100 ^{235}U and 100 neutrons react is put forward on the basis of available data. It indicates that the discovery of additional fission fragments is to be expected. W. R. A.

Absorption of cosmic-ray protons in lead. G. D. Rochester and M. Bound (*Nature*, 1940, 146, 745—746).—Data obtained in a cloud-chamber investigation of the absorption of cosmic-ray protons in Pb are recorded and discussed. The interpretations put forward of the results depend partly on the assumed place of origin of the protons and partly on the form of their spectrum. L. S. T.

Possibility of detecting a doubly-charged proton by the photographic method. H. J. Taylor, D. Fraser, and V. D. Dabholkar (*Nature*, 1940, 146, 777).—The resolving power of the method of exposing Ilford "R" plates to cosmic rays at high altitudes is insufficient to reveal the existence of doubly-charged protons. A decision by means of this method is unlikely. L. S. T.

Penetrating cosmic-ray showers. L. Jánossy (*Nature*, 1941, 147, 56—57).—Transition curves of penetrating cosmic-ray showers (cf. A., 1940, I, 242) in Pb and Al are reproduced and discussed. The rays are produced probably by the soft component of cosmic rays. The possibilities that the showers are cascade showers, or are due to meson production or a related process, are discussed. L. S. T.

Electric fields produced by cosmic rays. F. Evans (*Physical Rev.*, 1941, [ii], 59, 1—7).—Mathematical. Assuming the existence in interstellar space of a finite density of matter, four assumptions concerning the flow of currents are postulated and justified. With the help of these it is deduced that charge density and c.d. vanish in interstellar space, and that the existence in such space of cosmic rays as charged particles predominantly of one sign will result in the production of negligible electric fields. N. M. B.

(A) East-west asymmetry of cosmic radiation at high latitudes. F. G. P. Seidl. (B) East-west asymmetry of cosmic radiation at high latitudes and the excess of positive mesotrons. T. H. Johnson (*Physical Rev.*, 1941, [ii], 59, 7—10, 11—15; cf. A., 1935, 1297).—(A) Results calc. from observed data are reported.

(B) The observed asymmetry is interpreted as due to the deflexion by the earth's magnetic field of the mesotron component while the rays are losing energy by ionisation in the atm. Assuming that deflexions without energy loss (as for the Lemaître-Vallarta type primary rays) result in a

symmetrical distribution for the energy concerned, the asymmetry is traced to the difference between the actual deflexion and that of a ray which loses no energy. Calc. results agree with observed vals. N. M. B.

Excited states of nuclear particles in the meson-pair theory. C. L. Critchfield (*Physical Rev.*, 1941, [ii], 59, 48—52).—Mathematical. An improved meson-pair theory is developed without the use of perturbation calculations. N. M. B.

Protons of double charge and the scattering of mesons. H. J. Bhabha (*Physical Rev.*, 1941, [ii], 59, 100—101).—The consequences of a theory predicting the existence of protons of charge $2e$ and $-e$ (cf. A., 1940, I, 309) are discussed, and a new formula for the scattering of transversely polarised mesons caused by the spin of the heavy particles is presented. N. M. B.

Stability and magnitude of electronic charges. II. Scalar wave functions. A. Landé and L. H. Thomas (*J. Franklin Inst.*, 1941, 231, 63—70; cf. A., 1941, I, 70).—Mathematical. If the electronic particle has a fundamental length a , written in the form $a = \gamma e^2/mc^2$, then γ is found to have the val. $4 \times (\frac{2}{3})^{\frac{1}{2}}$ when a is the diameter of Thomson's cross-section σ of a free electric particle scattering infra-red light, or is found from the relation $a^2 = 2\sigma$, giving $\gamma = 4 \times (\pi/3)^{\frac{1}{2}}$, from which the Sommerfeld fine-structure const. $\alpha = \mu/\gamma = 1/137.1273$, where $\mu = amc/h$. The derivation of the proper vals. of μ is examined. N. M. B.

Upper limit of temperature. (A) C. Rosenblum. (B) F. G. Brickwedde. (C) W. Copulsky. (D) C. Rosenblum (*J. Chem. Educ.*, 1940, 17, 438, 543—544, 544, 544).—(A) The upper limit for at. H, calc. from the kinetic theory and the ideal gas law, is $3.58 \times 10^{12} \text{ K}$.

(B) A criticism and a discussion of temp. scales.

(C) Constancy of mass with increasing velocity cannot be assumed. The highest temp. which H can reach before being converted into radiant energy is $2.2 \times 10^{12} \text{ K}$.

(D) A reply to the above.

L. S. T.

Application of Mie's electromagnetic theory to the measurement of the size of small drops. G. R. Paranjpe and S. S. Lajami (*J. Univ. Bombay*, 1940, 9, Part 3, 38—54).—Mie's theory has been applied to the scattering of light by small drops, and the angles of the first min. of intensity in the forward direction are derived graphically. The results are compared with the corresponding vals. derived from Rayleigh's theory and the circular disc. theory. J. W. S.

General theory of spectra. II. M. H. Stone (*Proc. Nat. Acad. Sci.*, 1941, 27, 83—87; cf. A., 1940, I, 342).—Mathematical. The theory of lattice-ordered abelian groups is discussed and an integration-free treatment of Riesz's operational calculus in a linear lattice is derived. W. R. A.

Modified atomic volume plots. T. Moeller (*J. Chem. Educ.*, 1940, 17, 441—442).—At. vols. are plotted against the long form of the periodic table. L. S. T.

II.—MOLECULAR STRUCTURE.

Potential energy functions for diatomic molecules. H. M. Hulburt and J. O. Hirschfelder (*J. Chem. Physics*, 1941, 9, 61—69).—Two additional spectroscopic consts., $\omega_e x_e$ and a_e , are used to improve the usual three-parameter Morse curves derived from D , r_e , and ω_e for diat. mols. (cf. A., 1929, 975). The improved potentials generally lie above the Morse curves and for fairly large internuclear separations the corrections may be 10% of the energy of dissociation. J. W. S.

Band spectrum of BN. A. E. Douglas and G. Herzberg (*Canad. J. Res.*, 1940, 18, A, 179—185).—Two new band systems (a triplet and a singlet system) have been observed in a discharge through He containing traces of BCl_3 and N_2 . They are due to BN, and a vibrational and rotational analysis of the triplet system shows that it represents a $^3\Pi \rightarrow ^3\Pi$ transition, and is probably analogous to the Swan bands of C_2 . The vibrational frequencies in the upper and lower states are $\omega_e' = 1317.5$ and $\omega_e'' = 1514.6 \text{ cm}^{-1}$. The rotational consts. are $B_e' = 1.555$, $B_e'' = 1.666$, $a_e' = 0.010$, and $a_e'' = 0.025 \text{ cm}^{-1}$. The moments of inertia for the upper and lower states are 18.00×10^{-40} and $16.80 \times 10^{-40} \text{ g.-cm}^2$, and the internuclear distances r_e' and r_e'' are 1.326 and 1.281 Å . F. J. G.

Flame spectrum of carbon monoxide. A. G. Gaydon (*Proc. Roy. Soc.*, 1940, A, 176, 505—521).—The spectrum of CO burning in air and in O_2 at reduced pressure was photographed on high-contrast plates to display the band spectrum clearly. Analysis of the spectrum shows that the bands occur in pairs with a separation of about 60 cm^{-1} ; many of the strong bands are arranged in arrays with intervals of 565 and 2065 cm^{-1} . The emitter of the spectrum is discussed: it seems unlikely that the bands can arise from either the suboxide C_3O_2 or the peroxide CO_3 . CO_2 is the most likely emitter of the banded part of the CO flame spectrum; it is suggested that some of the peculiarities of the combustion of CO are due to a transition from a triangular electronically excited CO_2 mol. to the linear unexcited state, the mols. after this transition being left with very large vibrational energy.

G. D. P.

True measure of relative band intensities. N. R. Tawde and V. S. Patankar (*J. Univ. Bombay*, 1940, 9, Part 3, 16—23).—Various methods of measuring the relative intensities of the bands of a system are discussed. The ratio of the integrated to peak intensities has been determined for the second positive system of N_2 . Agreement is good for bands of $\lambda >$ that of the (0,0) band (3371 Å.), but at lower λ the peak intensity vals. are $>$ the integrated intensities, probably owing to an over-estimate of the former due to the J -vals. for the heads increasing with decreasing λ .

J. W. S.

Absorption spectra of nitrogen dioxide, ozone, and nitrosyl chloride in the vacuum ultra-violet. W. C. Price and (Miss) D. M. Simpson (*Trans. Faraday Soc.*, 1941, 37, 106—113; cf. A., 1939, I, 298).—Absorptions have been measured down to 1000 Å. In NO_2 Rydberg-type bands were observed; these give $12.3 \pm 0.2\text{ v.}$ for the ionisation potential, in which a $2p[O]$ non-bonding electron is concerned. O_3 is nearly transparent between 2300 and 1600 Å., below which absorption due to O_2 formed by photo-dissociation obscures that due to O_3 . It is inferred that certain band systems having wide vibrational structure are due to the excitation of π bonding electrons. The spectra of several bent triat. mols. are compared and an attempt is made to correlate them with the respective heats of formation of the mols.

F. L. U.

Vibration energy levels and specific heat of ethylene. E. J. Burcik, E. H. Eyster, and D. M. Yost (*J. Chem. Physics*, 1941, 9, 118—119).—The Bonner assignment of the torsional level of C_2H_4 yields a more reasonable explanation of the weak combination and harmonic lines of the Raman spectrum than does Conn and Sutherland's assignment (A., 1939, I, 549). It also leads to vals. of the heat capacity in much better accord with measured vals. The theoretical heat capacities at $150^\circ - 450^\circ\text{K.}$ follow the empirical relation $C_p^\circ = 9.638 - 3.109 \times 10^{-2}T + 1.551 \times 10^{-4}T^2 - 1.426 \times 10^{-7}T^3$.

J. W. S.

Light absorption of organic compounds. IX. Unsaturated carbonyl compounds and semicarbazones. A. Burawoy (*J.C.S.*, 1941, 20—24).—Vals. of the λ and extinction coeff. (ϵ) at the absorption max. are given for citral, citrylidene-acetaldehyde and -crotonaldehyde (I), β -cyclocitral (II), α -, β -, and ψ -ionone, their semicarbazones, and the phenyl-semicarbazones of (I) and (II); ϵ - λ curves are also given for $\lambda = 2000$ —4000 Å. The correlation of differences in absorption and structure is discussed.

A. J. E. W.

Vibration spectra of certain condensed gases at the temperature of liquid nitrogen. I. Experimental methods: (A) **Infra-red spectra.** G. K. T. Conn, E. Lee, and G. B. B. M. Sutherland. (B) **Raman spectra.** G. B. B. M. Sutherland and Cheng-Kai Wu. **II. Infra-red and Raman spectra of hydro- and deuterio-chloric acid at liquid nitrogen temperatures.** E. Lee, G. B. B. M. Sutherland, and Cheng-Kai Wu (*Proc. Roy. Soc.*, 1940, A, 176, 484—493, 493—504).—I (A). The infra-red spectrometer is described; it is of the Pfund-Barnes type designed for the investigation of mols. in the gaseous state at room temp. and the study of thin layers of solidified gases at low temp. The absorption cell, detector system, and calibration of the instrument are described.

I (B). The special Dewar vessel for the observation of Raman spectra at low temp. is described; it is especially suitable for small quantities of material.

II. The infra-red absorption spectrum of HCl was recorded at the temp. of liquid N about 20° below the transition point at 98°K. It consists of two bands with max. at 2701 and 2744 cm^{-1} , each showing fine structure; there are indications of a third band. The Raman spectrum at the same temp.

D 2 (A., I.)

also shows a doublet structure, whilst at higher temp. only a single line is observed, the difference being due to the association of HCl mols. in the solid state. The absorption spectrum of DCl was observed under the same conditions; three max. and traces of other structure were recorded. The results are in agreement with the low symmetry of solid HCl revealed by X-ray analysis.

G. D. P.

Polymerisation of dyes in solution. Thionine and methylene-blue. E. Rabinowitch and L. F. Epstein (*J. Amer. Chem. Soc.*, 1941, 63, 69—78).—The extinction curves of thionine (Thio) and methylene-blue (MB) have been determined at different concns. and temp. in H_2O , EtOH, and EtOH- H_2O mixtures. The curves indicate that the spectra are made up by the superposition of two bands, the M -band which for H_2O is more prominent in dil. solution, and the D -band stronger in conc. solution. In H_2O deviations from Beer's law appear even at the lowest concns. ($<10^{-6}$ mol. per l.) and are explained quantitatively by the formation of dimeric ions $Thio_2^{++}$ and $(MB)_2^{++}$ to which the D -band is ascribed, the M -band being ascribed to the monomeric ions $Thio^+$ and $(MB)^+$. In H_2O and dil. EtOH, increase of temp. has a similar effect to dilution, the intensity of the M -band increasing, whilst in more conc. EtOH mixtures a reverse effect is observed. Dissociation consts. and heats and entropies of formation of the dimerides in H_2O have been calc. Dimerisation does not occur in pure EtOH and is reduced considerably in EtOH- H_2O mixtures. Dimeric ions do not fluoresce, hence self-quenching of fluorescence at higher concns. of dye is attributed to dimerisation; no self-quenching, however, occurs in EtOH. Dimerisation is considered a universal property of org. dyes fundamentally associated with the property of colour and can be interpreted quantitatively on London's theory of intermol. forces. Potential energy curves are given for the interaction of two $Thio^+$ ions in H_2O and in EtOH and, because of the ionic coulombic repulsion, dimerisation requires an activation energy. Other properties of dye solutions (oxidation-reduction potentials, conductivity, osmotic pressure) are in accord with the dimerisation hypothesis.

W. R. A.

Ultra-violet absorption in a series of chloropyrimidines in the vapour state and in solution. F. M. Uber and R. Winters (*J. Amer. Chem. Soc.*, 1941, 63, 137—141).—Broad bands are exhibited, between 2100 and 3000 Å., prominently in the vapour state and less prominently in solution by pyrimidine and its Cl_2 -, Cl_3 -, and Cl_4 -derivatives. With increasing no. of Cl absorption max. shift to longer $\lambda\lambda$ and mol. extinction coeffs. increase.

W. R. A.

Carcinogenic hydrocarbons. V. Comparison of the intensity of fluorescence of cholanthrene and its homologues. W. F. Bruce (*J. Amer. Chem. Soc.*, 1941, 63, 304—305; cf. A., 1941, II, 92).—The intensity of fluorescence (detailed) of cholanthrene is $<$ that of its 20-Me derivative, thus paralleling the carcinogenic activity, but that of the 20-Et and -Pr² derivatives is only slightly lower.

R. S. C.

Absorption spectra of derivatives of 1:2-benzanthracene. R. N. Jones (*J. Amer. Chem. Soc.*, 1941, 63, 151—155).—Absorption spectra for 21 derivatives of 1:2-benzanthracene and their fluorescence in the solid state and in solution are reported and qualitatively discussed.

W. R. A.

Absorption spectra of alkylchrysenes. R. N. Jones (*J. Amer. Chem. Soc.*, 1941, 63, 313—314).— $\lambda\lambda$ and intensities of max. in the region 2700—3800 Å. have been determined for solutions in EtOH of 5-methyl- (I), 4:5- (II) and 5:6-dimethyl- (III), and 4:5-methylene-chrysene (IV). (I) and (II) give spectra closely resembling that of chrysene but (III) shows less similarity. In the spectrum of (IV) increased fine structure is shown in agreement with the corresponding increased amount of fine structure which is found for 1:2-benzanthracene derivatives containing a bridge methylene group (cf. preceding abstract).

W. R. A.

Spectroscopic properties of $\beta\beta'\beta''$ -trichlorotriethylamine.—See A., 1941, II, 35.

Induction, resonance, and dipole moment. C. P. Smyth (*J. Amer. Chem. Soc.*, 1941, 63, 57—66).—The dipole moments in the vapour state are recorded for Bu^aCl 2.09, Bu^bCl 2.04, sec - $BuCl$ 2.12, Bu^cCl 2.13, $MeNO_2$ 3.5, Pr^aNO_2 3.72, Pr^bNO_2 3.73, Bu^dNO_2 3.71 D. These data, combined with existing dipole moment data for vapours, are used to extend previous conclusions on the inductive effects in straight and branched C chains. No detectable differences in μ exist corresponding

with differences in chemical reactivity between halogens or H on primary, *sec.*, and *tert.* C atoms. The moments of fluoromethanes and fluorochloromethanes should not be appreciably affected by polar structures containing doubly-bonded halogen, the contributions of such structures being masked by inductive effects. From the vals. of μ for solutions of Ge and Pb halides the bond moments of Ge-Cl and Pb-Cl are calc. to have min. vals. of 2.0 and 4.1 D. Using these vals. with the val. for Sn-Cl and μ for KCl, KI, and NaCl, the amount of ionic character in each of these bonds is computed and is in fair agreement with vals. calc. from electronegativities derived from thermal data. The amounts of double bond character in C-halogen bonds in monohalobenzenes have been calc. from observed μ vals. but are < those computed from bond lengths. The amounts of resonance contributions calc. from μ vals. cannot be ascertained with great exactness.

W. R. A.

Dipole moment and molecular structure of higher fatty acids. G. R. Paranjpe and P. Y. Deshpande (*J. Univ. Bombay*, 1940, 9, Part 3, 24—37).—From ϵ and n_D measurements on C_8H_{16} solutions, and on the assumption that the at. polarisation is 15% of the electronic polarisation, the following dipole moments (in D.) at 25° have been determined; lauric acid 0.75, myristic acid 0.77, palmitic acid 0.77, trilaurin 2.59, and palmitone 2.12. The vals. for the acids, which apply to dimeric mols., lead to a structure of the CO_2H groups in such mols. in which the H of one mol. is chelated to the O of the other, the O-H-O, O-C-O, and C-O-H angles being 180°, 125°, and 110°, respectively.

J. W. S.

Dipole moments and resonance in the tetronic acids. W. D. Kumler (*J. Amer. Chem. Soc.*, 1940, 62, 3292—3295).—The following vals. of dipole moments in dioxan have been measured at 25°: tetronic acid (I), 4.72; α -chlorotetronic acid, 5.69; α -bromotetronic acid, 6.00; Me α -bromotetronate, 6.19; α -iodotetronic acid, 5.59; Me α -iodotetronate, 6.12; L-ascorbic acid, 3.93 D. Tetronic acids are possibly keto-enol tautomers. Calc. vals. for possible mol. configurations are given and it is concluded that (i) (I) is essentially in the enol form in dioxan, (ii) a resonating form involving a separation of charge contributes to the structure of the mol., and (iii) the OH is fixed in the plane of the ring with the H of the OH oriented toward the α -C. These conclusions are substantiated by the results for α -halogen-substituted acids and by the Me esters. The apparently low val. for ascorbic acid compared with that for (I) is explained on the basis of resonating forms of $\alpha\gamma$ -diketones, β -ketonic esters, and β -ketonic γ -lactones.

W. R. A.

Densities and refractive indices of liquid paraffin hydrocarbons. M. L. Huggins (*J. Amer. Chem. Soc.*, 1941, 63, 116—120).—Recent data for ρ for normal paraffin hydrocarbons yield the equation $V_n = 26.96 + 16.49n + (29.0/n)$ for the calc. molal vol. of a mol. containing n C atoms; molal vols. of non-normal paraffins are represented by $V = V_n + \text{const.}$ Mol. refractions for normal paraffins are given by $R_n = 2.12 + 7.815n$ and the vals. of $R - R_n$ are const. for series of non-normal paraffins. The bond refractions of C-C and C-H depend on the no. of C and H atoms attached to each C of the linking. Equations for computing R from their formulæ are given.

W. R. A.

Effect of the rotation of groups about bonds on optical rotatory power. W. Kauzmann and H. Eyring (*J. Chem. Physics*, 1941, 9, 41—53).—A comparison of the mol. rotations, $[M]_D$, of various optically active cyclic and open-chain compounds shows that $[M]_D$ is reduced markedly if the groups surrounding the asymmetric atoms possess a threefold axial symmetry about the bonds uniting them to the asymmetric atom, this symmetry being either inherent in the groups or acquired by them through free rotation about these bonds or by their orienting themselves equally in each of the three possible equilibrium positions about each bond. $[M]_D$ is thus a measure of the freedom of orientation about single bonds of the groups in an asymmetric mol. This has an important effect on the temp. coeff. of $[M]_D$ and accounts for the large differences observed between the $[M]_D$ for liquids and cryst. solids. This theory is applied to the elucidation of the structures of certain S compounds, polypeptides, and proteins.

J. W. S.

Dispersion of magnetic double refraction in the short infra-red spectrum. F. J. Davis (*J. Opt. Soc. Amer.*, 1940, 30, 488—494).—The dispersion of the Cotton-Mouton effect in CS_2 , C_6H_6 , PhCl, PhNO₂, PhMe, C_6H_5Me , NO_2 , and halowax

oil at 20° has been studied at $\lambda = 0.65$ — 1.6μ . For each liquid the ratio of the Cotton-Mouton const. (C) to the Kerr const. is const. within the experimental error ($\sim 1\%$). In general the observed C - λ curves are slightly less steep than those given by Havelock's law, but the observed and calc. C vals. differ by $> 6\%$; the agreement shows that the magnetic and optical anisotropies of the liquids are approx. independent of λ .

A. J. E. W.

Momentum distribution in molecular systems. I. The single bond. C. A. Coulson. **H. Carbon and the C-H bond.** C. A. Coulson and W. E. Duncanson. **III. Bonds of higher order.** C. A. Coulson (*Proc. Camb. Phil. Soc.*, 1941, 37, 55—66, 67—73, 74—81).—I. The momentum distribution in mols. in which only single bonds occur is dealt with, using the Dirac transformation theory of space wave functions. Two approximation methods are employed, the mol. orbital method, in which single electron momentum functions are calc., and the electron-pair method. In each case, the presence of the bond decreases the mean component of the velocity in the direction of the bond, increases the mean component of velocity perpendicular to the bond, and increases the mean momentum averaged over all directions. The theory is applied to H_2^+ and H_2 . Contours of const. momentum density are obtained for H_2^+ . The mean radial distribution functions for the two mols. are given, and the mean momentum for both is calc. The results are discussed in connexion with the experimental results of Hicks on the Compton line and scattering of fast electrons in H_2 (A., 1937, I, 580).

II. The momentum distribution for an electron in one of the hybridised orbitals of a C atom is calc., and is obtained as a function of the degree of hybridisation. The mean momentum increases with increasing coeff. of mixing (σ). The momentum of the C-H bond is also considered on the assumption that the bond is homopolar. This momentum also depends on the degree of s - p mixing, an increase in the proportion of p -binding increasing the mean momentum, but the effect is < in the case of the isolated at. orbital. The mean momentum for the C-H bond is < for the isolated C at. orbitals, but > for an isolated H atom over the greater part of the range of σ .

III. The momentum distribution of double bonds and conjugated bonds is considered, with special reference to C_2H_4 , C_6H_6 , and $(CH_2)_n$. The mean radial distribution function shows that the mean momentum of the electrons is < if they were rigidly attached to their own particular nuclei. Polar diagrams (contours of const. probability) indicate that the component of momentum perpendicular to the bond is > that along it, and if electron mobility is high in any direction in a mol., momentum is usually small in that direction.

A. J. M.

Revisions of the covalent radii and the additivity rule for the lengths of partially ionic single covalent bonds. V. Schomaker and D. P. Stevenson (*J. Amer. Chem. Soc.*, 1941, 63, 37—40).—For essentially covalent single bonds bond lengths are given by the sum of the appropriate covalent radii but certain mols., e.g., F_2 , N_2H_2 , H_2O_2 , show deviations. The length of a single bond A-B is given by $r_{AB} = r_A + r_B - \beta(x_A - x_B)$ (i), where r_A and r_B are normal covalent bond radii, β is a const. = 0.09, and $x_A - x_B$ is the difference between the Pauling electronegativities of A and B. Therefore, $-\beta(x_A - x_B)$ is a measure of the extra ionic character of the bond A-B. Vals. of covalent single bond radii are calc. for about 20 atoms and compared with the Pauling-Huggins vals. Observed bond lengths in diat. mols. (alkalis, alkali hydrides and halides, H halides) are compared with vals. calc. from $r_A + r_B$ and from equation (i). With polyat. mols. the vals. for diat. bond lengths calc. by equation (i) are compared with experimental vals. and with $r_A + r_B$ and Pauling-Huggins vals. from covalent radii. Generally the additivity of bond radii is valid only when correction is made for the ionic character of the bond. New vals. of normal covalent single-bond radii for H, N, O, and F are given which are consistent with ascertained bond lengths in H_2 , N_2H_2 , H_2O_2 , and F_2 .

W. R. A.

Hyperconjugation. R. S. Mulliken, C. A. Rieke, and W. G. Brown (*J. Amer. Chem. Soc.*, 1941, 63, 41—56).—Hyperconjugation (A., 1939, I, 353), the conjugation of a group such as Me with other groups containing double or triple bonds, has been investigated by quantum-mechanical computations on typical mols. using the mol. orbital (MO) method. The at. orbital method (AO) can also be applied but is more cumbersome. From the MO viewpoint the Me group can be written as $-C\equiv H_3$ and compared with $-C\equiv N$ and $-C\equiv CH$. Differ-

ences in conjugating power are quantitatively expressible in terms of a parameter related to the strength of the triple bond. Although $C\equiv H_3$ is more saturated than $C\equiv C$ and therefore has less tendency to conjugate, it still has considerable power of conjugation as indicated by calculations from thermal and bond distance data. Three general types of conjugation are recognised: (a) ordinary (first-order) conjugation as in $HC\equiv C-C\equiv CH$ or $N\equiv C-C\equiv N$; (b) second-order conjugation (first-order hyperconjugation) as in $H_3\equiv C-C\equiv CH$ or $H_3\equiv C-C\equiv N$; (c) third-order conjugation (second-order hyperconjugation) as in $H_3\equiv C-C\equiv H_3$. Accordingly all saturated org. mols. are stabilised by (c). The single and multiple bonds of a conjugated system are classified as acceptor and donor bonds, respectively; type (a) conjugation causes a shortening of acceptor and a lengthening of donor bonds. There is thus a net energy of conjugation (resonance energy) and this has been shown to be the sum of a positive, stabilising energy located in acceptor bonds and a negative energy located in donor bonds. In type (c) conjugation in saturated hydrocarbons C-H bonds are donor and C-C bonds predominantly acceptor, i.e., simultaneously donor and acceptor but with acceptor properties the more pronounced; the gains in stability by acceptor bonds are quite large but the losses by donor bonds are very small. Energy of conjugation is regarded as energy of delocalisation resulting from the passage from localised MO's to non-localised MO's. MO's are derived by the linear combinations of at. orbitals (LCAO) method. Observed energies of conjugation and hyperconjugation agree well with val. calc. on the theory advanced provided that two parameters (characteristics discussed) are suitably chosen. One of these parameters has hitherto been regarded as the resonance integral but is shown to be only $\sim 10\%$ of the val. of the resonance integral and for $C=C$ bond distance of 1.33 Å. is ~ 45 kg.-cal. per g.-mol. Type (c) conjugation is considered to be present in all org. mols. and reduces bond lengths. Normal C-C bonds have $\sim 11\%$ double bond character and normal, unconjugated $C=C$ bonds $\sim 12\%$ triple bond character as a result of hyperconjugation. Conjugation energies have been computed for CMe_3CH , C_2H_6 , $(CH_3C)_2$, $(CH_2CH)_2$, C_2H_4 , C_2H_6 , C_4H_6 , and $(CMe)_2$. Type (b) conjugation energies between Me or CH_2 groups and double bonds are given for 14 mols. and the relation between bond length and bond order is discussed. The theory is used to explain the observed decrease in the heats of hydrogenation of unsaturated compounds on Me substitution.

W. R. A.

Molecular structure of myosin.—See A., 1941, II, 56.

Structure of molecules and aggregates of molecules. J. G. Kirkwood (*J. Chem. Physics*, 1941, 9, 1—2).—Methods of investigating mol. structure and the applications of these measurements are discussed.

J. W. S.

Molecular distribution. J. E. Mayer and E. Montroll (*J. Chem. Physics*, 1941, 9, 2—16).—Functions by means of which the distribution of mols. in a system may be described are defined, and the relations between them are derived. Equations for the calculation of these functions from the mutual potential energy between pairs of mols. are also derived. Methods for the numerical evaluation of the functions are discussed.

J. W. S.

Theory of the transition in KH_2PO_4 . J. C. Slater (*J. Chem. Physics*, 1941, 9, 16—33).—Different possible arrangements of the H atoms in KH_2PO_4 crystals result in different orientations of the H_2PO_4 dipoles. As these have min. energy when oriented along the crystal axis there is a tendency for spontaneous polarisation, resulting in a transition, with polarisation, below the Curie point. The statistical theory is developed and found to predict a phase change of the first order. It is suggested that the change observed is a broadened first-order transition, the broadening being due to irregular shifts of the transition temp. due to stresses in different regions of the crystal. In general accord with experiment, the theory predicts that the magnetic susceptibility above the Curie point is 4.33 times the val. predicted by the Weiss theory. The predicted entropy change (0.69 unit) is $<$ the observed val. (~ 0.8 unit).

J. W. S.

Force constants in some organic molecules. B. L. Crawford, jun., and S. R. Brinkley, jun. (*J. Chem. Physics*, 1941, 9, 69—75).—The possibility that in a series of mols. involving the same bonds, the bond force consts. are only slightly changed from one mol. to another is investigated. In HCN,

C_2H_2 , C_2H_6 , CMe_3CH , $(CMe)_2$, and MeCN the bond structures demand 20 different bond consts., with which the 52 fundamental frequencies fit satisfactorily. The application of the treatment to Me halides is also investigated. The structural significance of force consts. is discussed.

J. W. S.

Mathematical methods for the study of molecular vibrations. E. B. Wilson, jun. (*J. Chem. Physics*, 1941, 9, 76—84).—Methods to simplify the calculation of vibration frequencies of complex mols. (A., 1940, I, 11) are described and illustrated by application to the MeCl mol.

J. W. S.

Theory of antiferromagnetism. J. H. Van Vleck (*J. Chem. Physics*, 1941, 9, 85—90).—By means of the Dirac vector model, expressions for the magnetic susceptibility (χ) of a medium with antiferromagnetic exchange coupling are derived. The theory predicts a Curie temp. above which the internal field disappears and at which χ is a max. (1.5 times its val. at 0° K.). This accords with experimental data on MnO but not with those on MnSe. The relation of this theory to previous theories, of which it is a generalisation, is discussed.

J. W. S.

Molecular fields of force. S. Chapman (*Nature*, 1940, 148, 747).—A correction (cf. A., 1941, I, 30).

L. S. T.

III.—CRYSTAL STRUCTURE.

Diffuse reflexions on Laue photographs. K. Lonsdale (*Nature*, 1940, 146, 806).—Raman and Nilakantan's claims (A., 1941, I, 30) cannot be admitted. Photographs taken at liquid air temp. show that for KCl, $NaNO_3$, $CaCO_3$, and org. compounds the diffuse reflexions almost or completely disappear at -180° , while the Laue spots increase in definition and no. For the diamond, the diminution of intensity at liquid air temp. is slight, but the characteristic temp. of the diamond is high and a change of 200° relatively unimportant. The temp. changes are completely reversible, and it is unnecessary to suppose the phenomenon to be other than a temp. effect.

L. S. T.

Diffuse reflexions from diamond. H. A. Jahn and K. Lonsdale (*Nature*, 1941, 147, 88—89; cf. A., 1940, I, 348).—The changes in shape of modified (111) reflexions that occur when the orientation of the diamond crystal is varied have been investigated. When the crystal is rotated about the $[110]$ axis so that reflexion occurs from the other side of the vertical (111) plane, the angle of incidence, θ , is -21.9° , and for vals. of $\theta >$ or $< -21.9^\circ$, the modified reflexion is a triangle of three small spots surrounding a diffuse centre. For $\theta -26.8$ to -16.5° , the position of the centre of this triangle agrees with the Faxén formula $d_{111} \sin(\theta + \phi) = \lambda \cos \phi$, where λ is the wave-length, and ϕ the angle of reflexion. The radial apex of the triangle always points away from the accompanying Laue spot, and the triangle increases in size as θ departs from the Bragg angle, -21.9° . All three spots and the diffuse centre are due to characteristic radiation, and the modified reflexions, whether of these or other shapes given in other crystal orientations, are only slightly reduced in intensity by a lowering of temp. of 200° . The Faxén-Waller theory can give detailed agreement with experiment.

L. S. T.

Quantum X-ray reflexion in diamond. (Sir) C. V. Raman and P. Nilakantan (*Nature*, 1941, 147, 118—119; cf. A., 1940, I, 403).—The (111) reflexions of diamond fit the formula $2d \sin \psi \sin(I + \epsilon) = n\lambda \sin I$, when ψ is the glancing angle of incidence, ϵ is the angle between the static and dynamic stratifications, and I the inclination of the phase-waves of the lattice vibration to the static crystal planes. $I, 55^\circ \pm 1^\circ$, is one half the tetrahedral valency angle, indicating that the phase-waves of the lattice vibration giving the modified reflexions from the (111) planes of diamond are parallel to the (100) planes of the crystal lattice. It has been confirmed experimentally that, as expected, the intensity of the reflexions is practically unaffected by cooling to liquid air temp.

L. S. T.

Extra spots in Laue photographs. G. E. M. Jauncey (*Nature*, 1941, 147, 146).—A discussion of explanations proposed by Preston, Zachariasen, and Raman and Nath of the formula recently derived by Bragg for the intensity of X-rays scattered from a group of 8 point atoms at the corners of a cube, and of an expression for the position of the secondary max. intensity of the modified Bragg spot.

L. S. T.

Photographic Fourier syntheses. M. L. Huggins (*J. Amer. Chem. Soc.*, 1941, **63**, 66—69).—The photographic method, proposed by Bragg (A., 1930, 479), for making a Fourier summation from crystal diffraction data has been extended to give increased accuracy and more quant. results. In its present form it is applicable only to summations having a centre of symmetry. W. R. A.

X-Ray comparison of natural and synthetic starch.—See A., 1941, II, 60.

Reaction of formaldehyde with amino-acids. X-Ray diffraction study.—See A., 1941, II, 60.

Structures of complex fluorides. Stereochemistry of fluonobate and oxyfluonobate complexes. Crystal structure of potassium oxyfluonobate-potassium hydrogen fluoride, $K_2NbOF_5 \cdot KHF_2$. J. L. Hoard and W. J. Martin (*J. Amer. Chem. Soc.*, 1941, **63**, 11—17).—Equimol. aq. solutions of NbF_5 and KF yield $K_2NbOF_5 \cdot H_2O$, which is monoclinic and isomorphous with $K_2TiF_6 \cdot H_2O$ and, therefore, possibly has an octahedral $NbOF_5$ group. When aq. NbF_5 and excess of aq. KF react K_2NbOF_5 is formed which is isomorphous with K_2ZrF_6 and has, as preliminary X-ray diffraction work confirms, a cubic system. A limited amount of HF added to an aq. solution of NbF_5 and excess of KF gives a cryst. compound of empirical composition K_3HNbOF_7 , actually an aggregate of K' , HF_2' , and octahedral $NbOF_3$, and, therefore, having the salt-like structure $K_2NbOF_5 \cdot KHF_2$. In the presence of larger concns. of HF monoclinic K_2NbF_7 crystals are formed in which the symmetry of the NbF_7 group is C_2 (A., 1939, I, 359). The 7-co-ordination groups NbF_7 and $NbOF_7$ have quite distinct geometrical configurations. The ion NbF_8 appears to be non-existent but the analogous TaF_8 ion is known in Na_3TaF_8 . $K_2NbOF_5 \cdot KHF_2$ is monoclinic, with a 8.82, b 14.02, c 6.82 Å., β 86° 34', space-group C_{2h}^2 — $C2/c$, 4 mols. per unit cell. The Nb—F and Nb—O distances are 1.88 Å. and F—F separations from nearest neighbours ~ 2.65 Å. in the $NbOF_5$ group and ~ 2.30 Å. in the F_2 group. The compound is isomorphous with $K_2SnF_6 \cdot KHF_2$ and $K_2PbF_6 \cdot KHF_2$. W. R. A.

Crystalline behaviour of linear polyamides. Effect of heat-treatment. C. S. Fuller, W. O. Baker and N. R. Pape (*J. Amer. Chem. Soc.*, 1940, **62**, 3275—3281).—X-Ray studies of unoriented polyhexamethylene sebacamide and adipamide, solidified from melts at different cooling rates, indicate that the degree of polycrystallinity and perfection of the crystal lattice depend on the rate of cooling. Annealing completely quenched specimens, oriented and unoriented, restores the crystal lattice arrangement to an extent which increases with increasing annealing temp. The macromol. behaviour has been related to that of ordinary monomeric systems. A continuous increase in Young's modulus with decreasing rate of cooling has also been observed, indicating an increased degree of crystallinity. These results suggest that segments of the mols. may exist as cryst., mesomorphic, or amorphous regions in the solid polymerides and imply a considerable rotational freedom of chain mols. in the solid state. The data are discussed in terms of the segment theory of chain polymerides. W. R. A.

Determination of molecular symmetry in the $\alpha\beta$ -diethylbenzyl [$\gamma\delta$ -diphenylhexane] series. C. H. Carlisle and (Miss) D. Crowfoot (*J.C.S.*, 1941, 6—9).—X-Ray crystallographic measurements are carried out on $\gamma\delta$ -diphenylhexane (I), m.p. 89—90°, and the isomeric 4:4'-(OH) $_2$, -(NH $_2$) $_2$, and -(CO $_2$ Me) $_2$ -derivatives. (I) and its 4:4'-(NH $_2$) $_2$ -derivative have mols. containing a centre of symmetry, since both crystallise with 2 mols. in the unit cell and space-groups requiring four asymmetric units. (I) and its three derivatives belong to the *meso*-series. The isomerides of lower m.p. derived from the liquid form (II) of (I) all show crystal structures in which the asymmetric unit may well be the mol. itself and are racemic. Stereochemical arrangement of the atoms in the above *meso*-series is closely related to the form deduced for the natural sex hormones. Diagrams are shown. Disposition of atoms about the central C—C is of the *trans*-type characteristic of the junction between rings n and c of the sterol sex-hormone series. X-Ray data are also recorded for $\alpha\beta$ -diethylstilbene, $\alpha\beta$ -diethylstilbæstrol (+C $_6$ H $_5$), 4:4'-dimethoxy- $\alpha\beta$ -diethylstilbene, $\alpha\beta$ -diethylstilbæstrol dipropionate, and 4:4'-dihydroxy- $\gamma\delta$ -diphenyl- Δ^8 -hexadiene. A test for polarity was positive only in the

case of 4:4'-diamino- $\gamma\delta$ -diphenylhexane, m.p. 97—98° [i.e., derived from (II)]. A. T. P.

Relationships between lattice types and Brillouin zones. G. V. Raynor (*Phil. Mag.*, 1941, **31**, [vii], 131—138).—Theoretical. Processes are described by which the approx. form of the Brillouin zones can be deduced for a variety of lattice types, including complex structures to which it would be difficult to apply rigidly the more formal methods. L. J. J.

Brillouin zone for the gallium structure. G. V. Raynor (*Phil. Mag.*, 1941, [vii], **31**, 139—143).—From the structure data of Iaves and Bradley for the Ga lattice, the dimensions of Brillouin zones containing 5.4 and 3 electron states per atom are obtained. L. J. J.

Crystal structure of aluminium-black. W. O. Milligan and A. B. Focke (*J. Physical Chem.*, 1941, **45**, 107—108).—Al distilled under a pressure slightly > that required to form an Al mirror gives a black, soot-like deposit termed Al-black. An X-ray diffraction study of the deposit shows it to consist of colloidal Al of the same crystal structure as massive Al. The X-radiograms are the same whether the Al is deposited in air or in H $_2$, indicating that there is no reason for assuming that the colloidal particles are stabilised by traces of Al $_2$ O $_3$. C. R. H.

Crystal structure of iodic acid. M. T. Rogers and L. Helmholz (*J. Amer. Chem. Soc.*, 1941, **63**, 278—284).—Cryst. HIO $_3$ has space-group D_2^2 — P_{212121} , a_0 5.525 \pm 0.010, b_0 5.855 \pm 0.010, c_0 7.715 \pm 0.010 Å., 4 HIO $_3$ mols. per orthorhombic unit cell. Patterson and Fourier projections are discussed. Pyramidal IO $_3$ groups exist in the crystal with I—O distances 1.80, 1.89, and 1.81 Å., O—O distances 2.78 Å., and O—I—O angles 96°, 98°, and 101°. Other three O atoms are in positions approx. opposed to the three O in I—O linking and at distances of 2.45, 2.70, and 2.95 Å. making a distorted IO $_6$ octahedron with three strong and three weak linkings. The hydroxyl O has two nearest O neighbours at 2.78 Å. and thus two H bonds for each IO $_3$ group forming a moderately strong bifurcated bond. I atoms are surrounded by distorted octahedra of O atoms and the O atoms are in a nearly closest packed arrangement. The I atoms are not in the perovskite arrangement. W. R. A.

Crystal structures of heterocyclic organic compounds of analogous constitution. III. Phenazine and diphenylene dioxide. R. G. Wood and G. Williams (*Phil. Mag.*, 1941, [vii], **31**, 115—122; cf. A., 1941, I, 76).—Crystallographic, optical, and X-ray measurements on phenazine (I) and diphenylene dioxide (II) are recorded. The results are in agreement with a planar structure for both mols. (I) forms monoclinic holohedral crystals with $a:b:c = 2.61:1:1.39$, $\beta = 108^\circ 55'$; the unit cell contains 2 mols., with a 13.2, b 5.07, c 7.12, space-group $P2_1/a$ (C_{2h}^2); the refractive indices and optical axial angle are $n = 1.73$, $\beta = 1.82$, $\gamma = 1.96$, $2V = 83^\circ$. (II) forms similar crystals with $a:b:c = 2.99:1:2.30$, $\beta = 100^\circ 20'$; the unit cell has 4 mols. with a 15.2, b 5.07, c 11.7 Å., and is centred in the (100) plane; the space-group is Aa (C_2) or $A2/a$ (C_{2h}^2). A table is given summarising the principal data for eight mols. dealt with in this series of papers. L. J. J.

Electron diffraction intensities. S. Fordham (*Nature*, 1940, **146**, 807).—Variations in extinction due to irregular crystal shape or to anisotropy will explain, at least qualitatively, many of the differences between calc. and observed electron diffraction intensities. L. S. T.

Structure of the hydrides of boron. VI. AlB $_3$ H $_2$. J. Y. Beach and S. H. Bauer (*J. Amer. Chem. Soc.*, 1940, **62**, 3440—3442).—From electron diffraction measurements AlB $_3$ H $_2$ is planar except for the H atoms. 3 BH $_2$ groups are attached to the central Al at angles of 120°. B atoms are located near the centres of trigonal bipyramids formed from the 4 H and the Al. The interat. distances are Al—B = 2.14 \pm 0.02, B—H = 1.27 \pm 0.04 Å. and from these vals. an electron configuration has been deduced. W. R. A.

Polishing of solids and the mechanism of sliding on ice and snow. F. P. Bowden (*Soc. Chem. Ind. Victoria*, 1940, **40**, 240—250).—A lecture reviewing recent work on the production, nature, and properties of the Beilby layer. A. R. P.

Electron diffraction investigation of the molecular structures of tetrahydrofuran, 2:5-dihydrofuran, furan, dioxadiene, and

p-dioxen. J. Y. Beach (*J. Chem. Physics*, 1941, **9**, 54—55).—The C—O and C—C distances in tetrahydrofuran (I) and 2:5-dihydrofuran (II) are those predicted by the table of covalent radii (A., 1934, 350), viz., 1.43 and 1.54 Å., respectively. In furan (III) the C—O and C—C distances are 1.40 ± 0.03 and 1.46 ± 0.03 Å. if the C=C distance is assumed to be 1.35 Å., whilst in dioxadiene (IV) the C—O and C=O distances are 1.41 ± 0.03 and 1.35 ± 0.03 Å., respectively. The C—O—C angles are (I) $111 \pm 2^\circ$, (II) $110 \pm 3^\circ$, (III) $107 \pm 3^\circ$, and (IV) $116 \pm 4^\circ$. J. W. B.

Influence of intramolecular atomic motion on electron diffraction diagrams. P. Debye (*J. Chem. Physics*, 1941, **9**, 55—60).—The influence of at. vibrations and of free or hindered rotations of mol. groups on the scattering properties of mols. is discussed, and the radial distribution curve is calc. J. W. S.

Magnetic and thermal properties of crystalline copper sulphate at low temperatures. K. S. Krishnan (*Nature*, 1941, **147**, 87—88).—A discussion of recent results. L. S. T.

Dynamical determination of the elastic constants and their temperature coefficients for quartz. J. V. Atanasoff and P. J. Hart (*Physical Rev.*, 1941, [ii], **59**, 85—90).—A mathematical theory giving the relations between the elastic const. and the frequencies of piezoelectric vibration for an infinite homogeneous aeolotropic plate is developed, and its adaptation to finite plates is examined. Experimental results show that the method of using high-order harmonics eliminates edge effects and leads to accurate data. The calc. elastic const. and their temp. coeffs. show a small unexplained divergence from classical theory. Observations for 0—80° are reported, and additional data give results up to the α - β transition point. N. M. B.

The C_{44} elastic constant for β -quartz. J. V. Atanasoff and E. Kammer (*Physical Rev.*, 1941, [ii], **59**, 97—99).—The method previously described (cf. preceding abstract) gives the val. 35.75×10^{10} dynes per sq. cm. This differs by a factor of ~ 2 from the only other available val., but is justified by a study of its behaviour in the range 0—650° and the consistency of the val. from different cuts from different crystals. N. M. B.

Plastic and allotropic forms of sulphur. H. F. Schaeffer and G. D. Palmer (*J. Chem. Educ.*, 1940, **17**, 473—475).—A review. L. S. T.

IV.—PHYSICAL PROPERTIES OF PURE SUBSTANCES.

Resistance measurements on very pure silver, molybdenum, palladium, and platinum in the temperature range 1.2—273° K. K. Steiner and E. Fünfer (*Actes VII Congr. int. Froid*, 1937, **1**, 388—397; *Chem. Zentr.*, 1938, ii, 3787).—The resistance (R) of specially purified specimens has been measured at nine temp. R is approx. $\propto T^4$ at 8—40° K., but with Ag and Pt, and probably with Mo and Pd, the exponent deviates to vals. < 4 . The R - T curves for Ag and Pt are similar to those of Meissner and Voigt (A., 1931, 292). A. J. E. W.

High-frequency resistance of superconducting tin. H. London (*Proc. Roy. Soc.*, 1940, **A**, 176, 522—533).—The high-frequency resistance of Sn in the superconducting state ($T < 3.7^\circ$ K.) was measured at $\lambda 20.5$ cm. The resistance falls gradually as the temp. falls below the transition point in contrast with the sudden drop which occurs with d.c. The experimental results are in agreement with theory, which assumes the simultaneous presence of normal and superconducting electrons. In the normal state at low temp. ($T > 3.8^\circ$ K.) the conductivity for high frequencies is $<$ that for low frequencies. This result may be caused by the mean free path of the electrons becoming $<$ the penetration depth due to skin effect under the conditions of high conductivity and high frequency. G. D. P.

Decrease in resistance of constantan with a magnetic field at temperatures between 1° and 20° K. W. F. Giauque and J. W. Stout (*J. Amer. Chem. Soc.*, 1940, **62**, 3516).—The effect of a magnetic field on the resistance of constantan has been investigated at 1.47°, 4.29°, 10.67°, and 20.34° K. at each of the field strengths, $H = 850, 1600, 3000, 4100$, and 8300 gauss. The resistance decreases with magnetic field strength, the change being $\propto H^n$, where n is slightly > 1 at low field strengths and slightly < 1 at higher fields. At the temp. of liquid air the change is $\propto H^2$. W. R. A.

Thermal data. XIII. Heat capacities and entropies of creatine hydrate, dl-citrulline, dl-ornithine, l-proline, and taurine. H. M. Huffman and S. W. Fox (*J. Amer. Chem. Soc.*, 1940, **62**, 3464—3465).— C_p vals. from 87° to 300° K. have been measured for creatine hydrate, dl-citrulline, dl-ornithine, l-proline, and taurine and from these data vals. of $S_{298.1}$ are computed and are, respectively, 56.0, 60.8, 46.2, 40.8, and 36.8 g.-cal. per degree per mol. W. R. A.

Simultaneous determination of adiabatic and isothermal elasticities. H. F. Ludloff (*J. Chem. Physics*, 1941, **9**, 119—120).—The effects of the frequency (ν) and type of vibration and the form of the sample on the adiabatic or isothermal character of a proper vibration are discussed. If all three dimensions of the sample are equal, isothermal vibrations occur only at $\nu \nu <$ the first proper ν or $> 10^{11}$ cycles per sec. If, however, one dimension is small relative to the others, vibrations antisymmetrical relative to the longitudinal mid-plane of the sample are isothermal at low ν , whilst the symmetrical vibrations are all adiabatic. This should permit the simultaneous study of the two elastic moduli through the temp. range of phase transitions. J. W. S.

Homologous series of alkanes. Density and its temperature coefficient. G. Calingaert, H. A. Beatty, R. C. Kuder, and G. W. Thomson (*Ind. Eng. Chem.*, 1940, **33**, 103—106; cf. A., 1936, 309).—Selected, smooth vals. of the temp. coeffs. of the density for normal and branched-chain alkanes are obtained from literature data. The mol. vols. of the n -alkanes from C_4H_{10} to $C_{20}H_{42}$ in the liquid state at 20° are expressed by: $V = 30.392 + 16.375n + 74.44/n^2$ (n = no. of C atoms). Selected literature vals. and calc. vals. of d^{20} are in close agreement. Mol. vols. at 20° in any given homologous series of branched-chain alkanes, with the possible exception of the initial member in each series, differ from the vals. of corresponding n -isomerides by a const. amount, characteristic of the series. The use of this alignment method to detect doubtful vals. of d^{20} in the literature is illustrated. A. T. P.

Entropy of fusion of argon. O. K. Rice (*J. Chem. Physics*, 1941, **9**, 121).—From the Debye theory, an expression is obtained for the complete partition function per atom for the thermal motion in liquid A at the m.p. Combining this relation with the observed vals. of the vol. change during fusion, X-ray data for the liquid, and the d of the solid at the m.p., it is shown that the co-ordination no. in the liquid is 10 (cf. A., 1940, I, 17) and the entropy of fusion is 3.5 assuming no disorder in the solid or 3.1 corr. for disorder, as compared with an experimental val. of 3.35 entropy units. J. W. S.

Stability of crystal lattices. V. Experimental evidence on recent theories of the equation of state and the melting of solids. R. Fürth (*Proc. Camb. Phil. Soc.*, 1941, **37**, 34—54).—A no. of general rules concerning the mechanical and thermal behaviour of solids can be derived from Born's new theory of thermodynamics and the melting of crystals. A summary of the theory is given. The laws of Grüneisen and Lindemann for the normal m.p. can be deduced from the theory, and the effects of pressure on m.p., and of pressure and temp. on compressibility and elasticity coeffs. predicted by the theory are in satisfactory agreement with experiment. The connexion between breaking and melting is discussed, and a thermodynamical theory of the phenomenon is developed. An equation connecting heat of fusion and heat of sublimation is deduced on the basis of the "theory of holes" in liquids. The relation is approx. satisfied by most elements. A. J. M.

Interatomic potential curve and the equation of state for argon. O. K. Rice (*J. Amer. Chem. Soc.*, 1941, **63**, 3—11).—The relationships between the interat. potential energy (U) curve and the properties of solid A have been investigated from 0° to m.p. and a U - r^3 curve is derived and compared with similar curves obtained by previous investigators. The effects of disorder (premelting) distribution of frequencies of the normal modes of vibration of the solid on its physical properties, and possible deviations from Debye theory, are considered. The new U - r^3 curve gives a val. for the second virial coeff. of A in good agreement with the experimental val. W. R. A.

Critical constants and van der Waals' equation. R. R. Evans (*Chem. and Ind.*, 1941, 90—91).—The relation derived by Copley (A., 1941, I, 78) has no theoretical significance. A. J. E. W.

Thermal conductivity of liquids. M. R. Rao (*J. Chem. Physics*, 1941, 9, 120—121).—Assuming a liquid to comprise a no. of linear harmonic oscillators, each vibrating with the same frequency about a displaced equilibrium position, and assuming that thermal energy is transmitted during the very brief period of contact between mols., an expression can be derived for the thermal conductivity (K) of a liquid. With the simplifying assumption that transmission of thermal energy between mols. occurs when the energy difference of the two mols. has a const. val., it follows that $K = Ae^{BT}$, where A and B are consts., independent of temp. Consequences of this relation are discussed. J. W. S.

Adiabatic cooling [of air] consequent on the work done when it rises. F. Morán (*Anal. Fis. Quím.*, 1940, 36, 5—19).—Decrease of temp. of a rising column of air is due, not to expansion, but to adiabatic cooling, although the mathematical result is the same in either case. Expansion can occur without cooling if no work is done. F. R. G.

V.—SOLUTIONS AND MIXTURES (INCLUDING COLLOIDS).

Viscosities of aqueous solutions. G. S. Kasbekar (*J. Univ. Bombay*, 1940, 9, Part 3, 55—62).—The viscosities (η) of various aq. solutions of ZnCl_2 , $\text{Ca}(\text{CNS})_2$, $\text{Zn}(\text{CNS})_2$, and H_3PO_4 have been determined by the Ostwald viscometer method. d^{25} vals. for the $\text{Ca}(\text{CNS})_2$ and $\text{Zn}(\text{CNS})_2$ solutions are also recorded. The variation of η with the molality (m) of the solution is represented satisfactorily by Arrhenius' empirical relation $\eta = A^m$, where A is a const. With ZnCl_2 and H_3PO_4 solutions the vals. of $(\eta - 1)/m$ pass through a min. J. W. S.

Experiment illustrating diffusion. J. H. Gardner (*J. Chem. Educ.*, 1940, 17, 494).—Gelatin (I) in a test-tube is covered by an equal vol. of (I) coloured by the addition of a small crystal of fuchsin (II). The coloured gel is covered with paraffin to prevent putrefaction. Diffusion of (II) into the lower layer of (I) becomes apparent in 1 hr. L. S. T.

Specific gravity of the ternary $\text{CaO-Na}_2\text{O-SiO}_2$ glasses. XVIII. Specific gravity [and viscosity] of the glasses at 1000—1350° by the Stokes method. S. Inoue and I. Sawai (*J. Soc. Chem. Ind. Japan*, 1940, 43, 325—328B).—Data on ρ and η for $\text{CaO-Na}_2\text{O-SiO}_2$ glasses at 1000—1350° are recorded. ρ is not a linear function of temp. At const. $[\text{SiO}_2]$ η increases with increasing $[\text{CaO}]$, and at const. $[\text{CaO}]$ or $[\text{Na}_2\text{O}]$ η increases with increasing $[\text{SiO}_2]$. F. J. G.

Application of X-rays to the study of alloys. H. Lipson (*Nature*, 1940, 146, 798—801).—A review. L. S. T.

Precipitation in copper-beryllium alloys. F. W. Jones and P. Leech (*J. Inst. Metals*, 1941, 67, 9—24).—Alloys of Cu with 2—2.6% of Be consist of $\alpha + \beta$ phases when quenched from $>600^\circ$; on reheating at 2° per min. the β phase disappears at $175\text{--}200^\circ$, but the γ phase cannot be detected microscopically or by X-rays below 350° . At 620° a heat absorption of 1.6 g.-cal. per g. takes place corresponding with the re-formation of β from $\alpha + \gamma$. Max. hardness is obtained by reheating at 380° , at which temp. pptn. of γ is practically complete. Sp. heat-temp. curves for alloys quenched from $600\text{--}840^\circ$ show either two or three min. or inflexions, suggesting that pptn. proceeds in several stages which overlap, but no evidence as to the nature of these can be obtained by X-ray examination. Crystals of β or γ do not seem to serve as nuclei for pptn. when quenched supersaturated alloys are reheated. Pptn. occurs at temp. well below those expected, using normal vals. for the activation energy of diffusion; Becker's theory of nuclei formation does not explain this fact. A. R. P.

System platinum-mercury. I. N. Plaksin and N. A. Suvorovskaja (*J. Appl. Chem. Russ.*, 1940, 13, 677—685).—The temp.-composition curve suggests the compounds PtHg , decomp. at 159.1° , Pt_2Hg , decomp. at 236° , and Pt_3Hg , decomp. at 485.1° . The solubility of Pt in Hg rises from 0.02% at 17° to 1.2% at 172° . R. T.

Structure and properties of iron-nickel alloys.—See B., 1941, 1, 107.

Some properties of quaternary alloy equilibrium diagrams. A. J. C. Wilson (*Proc. Camb. Phil. Soc.*, 1941, 37, 95—101).—The geometrical rules which must be obeyed by equilibrium

diagrams of quaternary alloys are considered. The properties of the regions of existence of one-, two-, three-, or four-phase systems are discussed. A. J. M.

Solubility of methyl chloride in certain solvents. J. G. Mamedaliev and A. Kuliev (*J. Appl. Chem. Russ.*, 1940, 13, 735—737).—The corr. solubilities of MeCl at 20° are: C_6H_6 , 47.23, CCl_4 , 37.56, AcOH 36.79, EtOH 34.70, H_2O 3.03 vols. of MeCl at n.t.p. per vol. of solvent. R. T.

Hydrogen bonding and the solubility of alcohols and amines in organic solvents. XIII. M. J. Copley, E. Ginsberg, G. F. Zellhoefer, and C. S. Marvel (*J. Amer. Chem. Soc.*, 1941, 63, 254—256; cf. A., 1940, I, 438).—Solubilities of numerous volatile amines and alcohols in non-volatile polyhydric alcohols, polyethylene glycols and amines, amides, esters, and ethers are recorded. High solubilities of alcohols in polyethylene amines and *tert.* amides and of amines in polyhydric alcohols indicate that the $\text{O-H}\cdots\text{N}$ is much stronger than the $\text{O-H}\cdots\text{O}$ linking. R. S. C.

Theory of adsorption of gases on solids when the potential energy varies continuously over the surface. A. R. Miller and J. K. Roberts (*Proc. Camb. Phil. Soc.*, 1941, 37, 82—94).—The theory of adsorption in which it is supposed that there is a definite no. of adsorption sites on a surface, and that there is a fixed interaction energy between two particles adsorbed on neighbouring sites, but a negligible interaction between particles further distant, is extended by making the model approach more nearly to an actual surface. A one-dimensional film is considered, in which the potential energy of a single adsorbed particle varies continuously and periodically with its position on the surface, and where there is a repulsive force between adsorbed particles varying with their distance apart according to an inverse power law. The variation of the heat of adsorption with the fraction of sites occupied is considered, and it is shown that there is much less difference between the behaviour of mobile and immobile films than is indicated by the fixed interaction model. A. J. M.

Adsorption of vapours at solid surfaces and change of surface electrical potential. A. A. Frost and V. R. Hurka (*J. Amer. Chem. Soc.*, 1940, 62, 3335—3340).—The change of surface electrical potential of paraffin, collodion, and $p\text{-NH}_2\text{C}_6\text{H}_4\text{NO}_2$ caused by adsorption of inorg. and org. vapours has been investigated by two different methods. The vac.-tube electrometer method gives direct qual. results; the vibrating electrode method proves more satisfactory and yields quant. observations of change of potential with v.p., the curves obtained being similar to adsorption isotherms. The potential changes are attributed to dipole orientation at the surface and it is suggested that symmetrical mols., such as CCl_4 and C_6H_6 , on adsorption acquire induced dipoles. The observed potential changes vary from 5 to 500 mv. W. R. A.

Dynamics of adsorption of acetylene by silica gel from oxygen-nitrogen mixtures. I. P. Ischkin and P. Z. Burbo (*J. Appl. Chem. Russ.*, 1940, 13, 1022—1027).— C_2H_2 is removed from its solutions in liquid $\text{O}_2\text{--N}_2$ by filtration through SiO_2 gel. The process is one of adsorption. R. T.

Adsorption of acetylene on selective adsorbents. S. Bresler (*Acta Physicochim. U.R.S.S.*, 1940, 12, 783—785).—The possibility of selective chemisorption of C_2H_2 on ketones of high mol. wt. has been investigated. $n\text{-C}_{15}\text{H}_{31}\text{COMe}$, if pptd. from an alkaline medium, readily takes up 1—1.8 mols. of C_2H_2 per mol., the sorption being largely reversible. The activity of the adsorbent slowly decreases on keeping, and more rapidly on warming. Specimens pptd. from acid media have only a very low activity, suggesting that the active adsorbents are in the enol form, and that the loss of activity on keeping is due to a change to the keto-form. F. J. G.

Structure of adsorption layers. A. Buzagh (*J. Hungarian Chem. Soc.*, 1940, 1, No. 1, 3—4).—A new method is described for research on the structure of border phases between solids and liquids and for analysis of the nature and quantity of active forces regulating the stability or coagulation of colloid solutions. The method is also adapted for continuous measuring of the "breaking angle" (crit. angle at which the particles of a suspension deposited on a special wall of a container just fall away by slow overturning of the container), the sine of which angle is a measure of the adhesive force. Adsorption layers are found to be possibly >1 mol. thick. Experimental evidence is quoted of adhesion being due,

not to mass action, but to surface action based on the interaction of adsorption layers, and governed by the same rules as govern the formation, stability, and cessation of disperse systems. Experimental evidence is also quoted that adhesion of particles is determined by electric properties, viz., (a) thickness and electric charge of an electric double layer consisting of oriented dipoles, (b) orientation of mols. Further experiments are mentioned concerning the mechanism of coagulation of fibrous gels caused by dil. electrolyte solutions in emulsions of compounds of high mol. wt., especially proteins. It is inferred that fibre formation occurs, not at the isoelectric point where adhesion is max., but near this point, when the adhesive force is not yet strong enough to prevent free organisation of the particles. E. A.

Relationships between the adsorption isotherm and the spreading force. W. B. Innes and H. H. Rowley (*J. Physical Chem.*, 1941, **45**, 158—165).—Mathematical. Consideration of two methods of forming a film on a surface, by adsorption and by spreading from one part of the surface to another, both methods being reversible, leads to a relation between spreading force and adsorption isotherm data. A two-dimensional equation of state corresponding with the Langmuir adsorption isotherm gives a plot similar to that expected for a real two-dimensional gas. This equation of state is independent of the adsorption equilibrium const. in the Langmuir equation, indicating that where the latter equation applies, the equation of state is independent of attractive forces between adsorbent and adsorbate. C. R. H.

Internal surface of cellulosic materials. A. J. Stamm and M. A. Millett (*J. Physical Chem.*, 1941, **45**, 43—54).—Data for the selective adsorption of stearic acid (I) from org. solvents and of PhOH from H_2O by filter-paper and by cross-sections of sugar pine have been obtained. (I) is positively adsorbed from C_6H_6 solutions whereas the solvent is selectively adsorbed from solutions of (I) in EtOH and $COMe_2$. A polar solute, e.g., PhOH, when dissolved in a non-polar solvent is unable to enter the cell-wall structure. PhOH- H_2O solutions, however, are more readily adsorbed than H_2O alone. Vals. for the internal surface of cellulosic materials have been calc. from these data and from data for heats of swelling and adhesion tension. The internal surface of microscopically visible capillary structures calc. by various methods yields vals. of the same order of magnitude, viz., $\sim 2 \times 10^3$ sq. cm. per g., whereas the internal surfaces of swollen cell-wall structures are $\sim 3 \times 10^3$ sq. cm. per g. C. R. H.

Theoretical and experimental analysis of the capillary-rise method for measuring the surface tension of solutions of electrolytes. G. Jones and L. D. Frizzell (*J. Chem. Physics*, 1940, **8**, 986—997).—Langmuir's theory (A., 1939, I, 140) of the cause of the Jones-Ray effect (A., 1937, I, 126) is analysed and one of its premises is found to be inconsistent with experimental evidence that a solution-air interface is electrically charged. The apparent relative surface tensions of $ThCl_4$ solutions show normal behaviour over the concn. range 10^{-2} — 5×10^{-6} M., in spite of the fact that a max. exists in the ζ -potential-concn. curve. Also, contrary to Langmuir's theory, the addition of 10^{-6} M. $ThCl_4$ does not eliminate the Jones-Ray effect with KCl solutions, and the capillary rise in distilled H_2O is independent of the CO_2 content. J. W. S.

Surface tension of different dilutions of Boys' soap solution. N. Ramlal and S. B. Nizami (*J. Osmania Univ.*, 1939, **7**, 16—18).—Surface tensions of 0—30% Na oleate solutions in 25% aq. glycerol, determined by a dynamic (ripple) method, agree with vals. obtained by Mahajan (A., 1931, 1366) using a static method. F. L. U.

States of monolayers. W. D. Harkins and E. Boyd (*J. Physical Chem.*, 1941, **45**, 20—43).—General phase diagrams for monolayers on a liquid subphase afford evidence for the existence of two and possibly three phases exhibiting η relations attributed in three dimensions to the liquid state, and also a gas and a liquid phase. The transition from one to another of these five phases, the nature of triple points, the relation between mol. dimensions and the phase of a monolayer, changes from two- to three-dimensional systems, the compressibility of monolayers, and kindred subjects are discussed theoretically. C. R. H.

State of monolayers adsorbed at the interface solid-aqueous solution. F. M. Fowkes and W. D. Harkins (*J. Amer. Chem. Soc.*, 1940, **62**, 3377—3386).—By means of an improved

apparatus (described) contact angles between a liquid and the plane surface of a solid have been measured using the principle of the tilting plate. A theory is presented by which the film pressure can be determined. Adsorbed films consisting of NH_4Bu^+ , $AcOH$, Pr^+CO_2Na , Bu^+OH , Pr^+CO_2H , and $EtCO_2H$ are two-dimensional imperfect gases on paraffin, stibnite, graphite, or talc. The areas of the films at the solid-liquid and liquid-vapour interfaces are practically identical. Pressure-area relationships and wetting characteristics of the films depend on the type of polar group in the mols. The effect of chain length is discussed. All the films are unimol. layers. W. R. A.

Thermodynamics of films: energy and entropy of extension and spreading of insoluble monolayers. W. D. Harkins, T. F. Young, and E. Boyd (*J. Chem. Physics*, 1940, **8**, 954—965; cf. A., 1939, I, 467).—Equations are given for the entropy increase, heat absorption, heat content increase, and internal energy increase during the expansion of insol. monolayers. The two-dimensional phases are classified as gas, liquid expanded (L_1), intermediate, liquid condensed (L_2), and solid. They differ from three-dimensional systems in that the mean mol. distances can be increased considerably without destruction of the liquid state. The change from solid to L_2 exhibits zero latent heat, and hence is a phase change of the second order. The increase in heat content when the monolayer of $C_{11}H_{23}CO_2H$ (I) spreads over unit area is ~ 400 ergs per sq. cm. for a solid film, zero for the L_2 phase, rises gradually in the intermediate phase to an almost const. val. of 300 ergs per sq. cm., and decreases to ~ 50 ergs per sq. cm. in the L_1 phase. The heat content increase during the spreading of 1 g.-mol. of (I) at 18° is ~ 0.2 kg.-cal. for the solid phase, 8.3 kg.-cal. for the intermediate phase, and very small for the L_1 phase. At 25° the vals. for the intermediate and L_1 phases are ~ 4.6 and 1.0 kg.-cal., respectively. J. W. S.

Unimolecular films of saccharase [invertase]. H. Sobotka and E. Bloch (*J. Physical Chem.*, 1941, **45**, 9—19).—Experimental methods for the prep. and measurement of the thickness, area, and activity of films of highly purified yeast invertase (I) are described. Stable films on H_2O are possible when salts of Al, Fe, La, Zr, and especially Ce and Th are present. Built-up (I) films >45 Å. thick retain the full enzymic activity of the material from which the film has been made. It is possible that fractionation takes place to form an inactive fraction which is sol. and an active fraction which concentrates in the film layers. Wt. for wt. this second fraction may be more active than the original (I). C. R. H.

Laminar systems. XIV. Mechanism of the formation of thin films of copper sulphide on the surface of solutions. S. G. Mokrushin, V. A. Kosheurova, and I. A. Blum (*Kolloid. Zhurn.*, 1940, **6**, 119—127; cf. A., 1941, I, 39, 45).—Films of Cu_2S (or CuS) produced by gaseous H_2S on the surface of Cu salt solutions consist from the beginning of colloid particles as distinct from unimol. layers. When the duration t of the reaction increases the film becomes denser but not thicker. This is shown by measuring the area-pressure curve for films at various t . The shorter is t , the more compression is necessary to reach the pressure of 17 dynes per cm., but at this pressure the films crumble irrespectively of t ; their thickness is, therefore, independent of t . The mass of the film $S = S_0 kt / (1 + kt)$, S_0 and k being consts. This equation indicates that the rate of reaction is determined by that of the dissolution of H_2S . The final thickness is for 0.8N-, 0.08N-, and 0.008N- $Cu(NO_3)_2$, 44, 80, and 138 Å., respectively, and for 0.7N- and 0.07N- $CuSO_4$ 65 and 109 Å., since the particle size increases with dilution. J. J. B.

Statistical theory of duplex films. L. S. K. Feng and W. Band (*J. Chem. Physics*, 1940, **8**, 977—980; cf. A., 1940, I, 159, 209).—The dissociation treatment of condensing systems is applied to duplex films, and by making certain simple assumptions agreement is obtained with existing data on the saturated state of myristic acid films (A., 1926, 348; 1939, I, 467). J. W. S.

Structure of multilayers. I. G. Knott, J. H. Schulman, and A. F. Wells (*Proc. Roy. Soc.*, 1940, **A**, 176, 534—542).—Multilayers of long-chain compounds deposited on a transparent base have been examined microscopically and by X-rays. An X-ray photograph of a stationary multilayer of Et stearate is identical with that obtained by rotating a single crystal of β -Et stearate about the long axis of the cell.

The experiments show that the multilayer consists of micro-crystals all oriented with one axis normal to the surface on which the multilayer is deposited. The single crystals grow right through the layer ~ 1000 mols. thick. G. D. P.

Nature of foam. VII. Foam formation of mixed aqueous solutions of saponin and ethyl alcohol. T. Sasaki (*Bull. Chem. Soc. Japan*, 1940, 15, 449–454; cf. A., 1939, I, 520).—The persistence of foam produced in aq.-EtOH solutions of saponin (0.009085 and 0.001820 g. per l.) shows a max. at [EtOH] ~ 0.257 g.-mol. per l. It decreases rapidly with increasing [EtOH] > 0.77 g.-mol. per l. It is assumed that at lower [EtOH] the foam production and stabilisation are due to the saponin and EtOH, respectively, but that at higher [EtOH] both actions are due to EtOH, owing either to its preferential adsorption in the foam film or to its causing dehydration of the saponin particles. The effects noted are compared and contrasted with those observed with hydrophilic and hydrophobic colloids. J. W. S.

Foam stability. Foam produced in aqueous extract of the root of *Acanthophyllum paniculatum*, Rgl. K. N. Arbuzov (*Kolloid Shurn.*, 1940, 6, 63–69).—Roots of *Acanthophyllum* (grown in Turkestan) contain 22% of saponin (I) and 4% of sapogenin. The foaming capacity of an aq. extract from dried root is almost identical with that of purified (I) at an equal concn. The rate of draining of the foam is high (e.g., 10% per min.) at low concns. (0.25%), and low (e.g., 1% per min.) at high concns. (5%); for a given concn. it shows a max. when 30–50% of the foam has drained away. The root extract may be used industrially instead of pure (I). J. J. B.

Red gold sols. A. L. Elder (*J. Chem. Educ.*, 1940, 17, 512).—Borovskaja's method of prep. is preferred to that of Zsigmondy. 1 c.c. of 1% AuCl_3 is added to 95 c.c. of H_2O , and heated to 90–95°. 2.5–5 c.c. of 1% Na citrate (I) are added, and the solution is boiled for 1–1.5 min. A light cherry-red sol is obtained. Colour can be varied by changing the concn. of (I) and time of boiling. L. S. T.

General and electrochemical properties of Raifo's sulphur sols. A. Charin (*Acta Physicochim. U.R.S.S.*, 1940, 12, 703–721).—A no. of properties of the S sols obtained by addition of $\text{Na}_2\text{S}_2\text{O}_3$ to H_2SO_4 have been studied. The micelles contain considerable amounts of polythionate ions, but the intermicellar liquid is almost free from these at first. On keeping, the adsorbed polythionate ions are slowly liberated, this being accompanied by crystallisation of the S. Electro-metric titration curves with HCl, BaCl_2 , and MgCl_2 show that cation exchange occurs in the outer layer, with quant. equivalence. The sols have high vals. of ζ , which are markedly diminished by addition of BaCl_2 , owing to the strong adsorption of Ba^{++} ions, but less so by addition of HCl or NaCl. This electric charge is the main stabilising factor, but the disappearance of cataphoretic mobility before complete coagulation shows that hydration also plays a part. F. J. G.

Ion antagonism in Raifo's sulphur sols. A. Charin (*Acta Physicochim. U.R.S.S.*, 1940, 12, 722–736).—It has been shown by direct analysis that adsorption of Cl^- and SO_4^{--} ions by these sols (cf. preceding abstract) does not occur. HCl diminishes the adsorption of Ba^{++} ions, and still more that of Mg^{++} ions, and this is parallel to the antagonistic effect of HCl on the coagulation of the sols by MgCl_2 and BaCl_2 . Cation exchange plays an important part in the coagulation by BaCl_2 in the presence of small concn. of HCl or NaCl, but increase of [NaCl], or to a smaller extent of [HCl], diminishes the importance of this. Addition of EtOH or COMe_2 renders the sols sensitive to NaCl, but not to HCl. The greater antagonistic effect of HCl as compared with NaCl is ascribed to its greater hindering effect on the adsorption of bivalent ions, to a stronger binding of H_2O mols. in the micelle in presence of H^+ , and to a weaker dehydrating influence of HCl. F. J. G.

Chromium hydroxide sols. D. S. Datar and M. Qureshi (*J. Osmania Univ.*, 1939, 7, 5–11).—Changes in $\text{Cr}(\text{OH})_3$ sols caused by exposure to ultra-violet light were studied by measuring the extinction coeff. (ϵ) and electrical conductivity (κ). Short exposures lead to a decrease in ρ_H and an increase in κ , both of which effects are reversed by long exposures; ϵ vals. are increased. This behaviour may be explained by an increase in the hydrolysis of CrCl_3 adsorbed on the micelle, followed by an increase in particle size. Decrease of κ after

long exposure is due to the photochemical destruction of the HCl liberated by hydrolysis. F. L. U.

Colloidal clays. II. E. A. Hauser and D. S. Le Beau (*J. Physical Chem.*, 1941, 45, 54–65; cf. A., 1939, I, 23).—The cataphoretic velocity (v), η , and apparent ρ of purified, colloidal monodisperse fractions of Wyoming bentonite (I) have been determined. For concns. $< 0.5\%$ v is const. for a given particle size and increases with decreasing particle size. At higher concns. v decreases, the decrease being most marked with the smallest particle size fractions. This decrease in v occurs when the average distance between the particles is ~ 5.5 times the apparent diameter of the particles. ρ of (I) dispersed in H_2O is lower for extreme dilutions and higher for concns. $> 0.5\%$ than that of dry (I). The smaller the particles the lower is the concn. needed to exceed ρ for the dry (I). At low concns. H_2O causes swelling of the crystal lattice but as the concn. is increased a compression of the ionic atm. occurs which is synonymous with a decrease in swelling and an increase in the ρ of adsorbed H_2O . This in turn accounts for an increase in the apparent ρ of (I). In dil. solutions η is independent of particle size, but at higher concns. ($> 0.5\%$) η increases with concn. and with increase in particle size. The type of H_2O -adsorption in or around the particles and the gelation of systems of very low concn. are discussed. C. R. H.

Hydration of clay in water vapour and in liquid water. V. S. Scharov (*Kolloid. Shurn.*, 1940, 6, 3–14).—The v.p. of wet clay is already equal to that of H_2O at low H_2O contents, and the thermodynamical rule of a strict interdependence between H_2O content and v.p. breaks down for hysteresis of drying, syneresis, etc. Thermodynamic equations assuming a complete equilibrium should not be applied to H_2O -clay mixtures. J. J. B.

Influence of hydrophilic colloids on the rate of dissolution of metal oxides in acids. J. N. Berg and M. N. Vischniakov (*Kolloid. Shurn.*, 1940, 6, 71–78).—The rate of dissolution of CuO is reduced by colloids. The effect in N-HCl decreases in the order gelatin (I) $>$ agar (II) $>$ starch (III) $>$ gum arabic (IV), and in $\text{N-H}_2\text{SO}_4$ in the order (I) $>$ (IV) $>$ (II) $>$ (III); the effect is stronger in HCl than in H_2SO_4 . The effect on the rate of dissolution of $\text{Fe}(\text{OH})_3$ in HCl is small; it decreases in the order (I) $>$ (III) $>$ (II) $>$ (IV). It increases with the amount of colloid added, indicating an adsorption of the colloid by oxides. J. J. B.

Ageing of sols and gels. VIII. Alcosols of mercury acetamide. E. M. Preis (*Kolloid. Shurn.*, 1940, 6, 57–62; cf. A., 1941, I, 11).—Gelation of EtOH solutions of $(\text{NH}_4\text{C}_2\text{H}_3\text{O}_2)_2\text{Hg}$ (I) can be caused not only by nitrates etc. but also by chlorides, iodides, etc. which in aq. solution decompose (I). Salt concns. needed to induce gelation increase with the H_2O content of EtOH; e.g., for the three solutions 0.3N-(I) + 0.008N- NaNO_3 in abs. EtOH, 0.3N-(I) + 0.1N- NaNO_3 in 96% EtOH, and 0.3N-(I) + 0.1N- NaNO_3 in 75% EtOH, the gelation time is a few sec., 2 min., and 45 min., respectively; in 70% EtOH the mixture 0.3N-(I) + 0.1N- NaNO_3 does not gel at all. J. J. B.

Interaction of cellulose acetate with organic solvents. T. A. Granskaja and A. I. Kaliteevskaja (*Kolloid. Shurn.*, 1940, 6, 145–152).—Sorption by cellulose acetate (I) of C_6H_6 from mixtures of C_6H_6 and light petroleum (II) (b.p. 47–50°), and that of PhMe from PhMe-(II) mixtures, increases when the concn. of (II) decreases. The solubility of (I) in these mixtures is insignificant. The heat of sorption (wetting) rises from 0.42 cal. per g. in (II) first rapidly and then slowly towards the val. of 8.8 cal. per g. for C_6H_6 . It is concluded that the "solvation layer" is multimol. and the intensity of attraction is highest near the solid surface. J. J. B.

Polymerides. I. Highly elastic deformation in polymerides. A. P. Alexandrov and J. S. Lazurkin. II. Dynamic method for the study of elastic materials. J. S. Lazurkin. III. Technique of mechanical testing of soft and hard rubber and plastics. G. Gurevitch and P. Kobeko (*Acta Physicochim. U.R.S.S.*, 1940, 12, 647–668, 669–680, 681–702).—I. Highly elastic deformation involves re-orientation of the mols. under the imposed stress, and may be considered kinetically as a relaxation process associated with a relaxation time $\tau = Ae^{U/kT}$ where U is the potential barrier between the two configurations. The total deformation after time t is $D = D_{el.} + D_{h.d.}(1 - e^{-t/\tau})$, where $D_{el.}$ is the ordinary

elastic deformation and $D_{h,el,\infty}$ the final equilibrium val. of the highly elastic deformation. For a periodic stress of frequency ω this gives $D = D_{el} + D_{h,el,\infty}/(1 + i\omega\tau) = D_{el} + D' + D''$, D' and D'' being real and imaginary components. Experimental results for rubber and various high polymerides show a qual. agreement with this expression, at $\omega = 1 - 1000$ and $T = -80^\circ$ to 200° .

II. In view of the importance of time and temp. with regard to highly elastic deformation (see above) it is desirable to study the response of plastic materials to periodic stresses over a wide range of frequency and temp. An apparatus for this purpose is described. At room temp. the deformation of rubber is almost independent of ω ($\omega \gg 2000 \text{ min.}^{-1}$). The temp. at which the deformation becomes half that at room temp. depends on ω , according to $\log t_0/t = B(1/T_0 - 1/T)$ where $t = 1/\omega$.

III. The total elastic deformation of rubber subjected to a static stress for a limited time decreases with increasing degree of vulcanisation, but the initial deformation is almost unchanged. The usual methods for testing the mechanical properties of plastic materials fail to allow for the influence of time and temp. on the highly elastic deformation.

F. J. G.

Lyophilic system albumin-pectin. A. P. Saltschinkin and F. L. Movschovitch (*Kolloid. Shurn.*, 1940, 6, 15—27).—The ovalbumin (I) used had 0.2% of ash, p_H 6, and a negative cataphoretic mobility; the pectin (II), prepared from sugar beet, had 3.5% of ash, p_H 5, and was positive. Mixtures of (I) and (II) in H_2O were coagulated by warming for 5 min. at 60° if they contained 2—14 parts of (II) for 100 parts of (I); this was presumably due to the acid reaction of (II). The osmotic pressure of a mixture of 5 g. of (I) + 5 g. of (II) per l. is < that of 5 g. of (II) alone; this indicates formation of a complex between (I) and (II). The viscosity of (I) + (II) + H_2O , or of (I) + (II) + glucose + H_2O , or of (I) + (II) + starch + H_2O is raised by a short heating at 60° ; this may be due to a complex formation or to a denaturation of (I) which also increases η . Electrical conductivity of (I)—(II) mixtures is additive. Some mixtures of (I) + (II) + glucose + H_2O gel after heating at 70° .

J. J. B.

X-Ray examination of the structure of gelatin. I. I. Sokolov (*Kolloid. Shurn.*, 1940, 6, 99—108).—Gelatin boiled with H_2O for 3 hr. shows only an "amorphous circle"; the spacings 2.8 and 11 Å. disappear almost completely. Further heating for 45 hr. has no additional effect. Neither stretching of, nor addition of electrolytes to, this thermolysed gelatin affects its X-ray pattern. Treatment with CH_2O gives three spacings (2.79, 3.92, and 12.45 Å.) but they disappear on washing with H_2O . Ordinary gelatin when treated with CH_2O or electrolytes gives distinct spacings, e.g., with H_2SO_4 , 2.91, 3.01, 4.26, 7.35, and 10.55 Å., and with $NaOH$ 2.79 and 3.00 Å. (and two "amorphous rings"). $AcOH$ has no effect on the pattern of ordinary gelatin.

J. J. B.

Mutual coagulation of colloidal solutions. IV. Interaction of zinc ferrocyanide and (a) ferric hydroxide, (b) thorium hydroxide, and (c) ceric hydroxide. P. M. Barve, V. C. Vora, and B. N. Desai (*J. Univ. Bombay*, 1940, 9, Part 3, 69—75; cf. A., 1939, I, 255).—As in systems investigated previously, the width of the zone of mutual coagulation of $Fe(OH)_3$, $Th(OH)_4$, and $Ce(OH)_4$ sols by $Zn_2Fe(CN)_6$ sols is a min. when the charge on the particles is a max. The min. val. of the width of the zone in different pairs appears to depend also on the hydration of the hydroxide particles.

J. W. S.

Rhythmic precipitation. T. Moeller (*J. Chem. Educ.*, 1940, 17, 519).—Banded structures of $Co(OH)_2$ in gelatin are illustrated. 5 ml. of 0.1M- $Co(NO_3)_2$ are added to 30 ml. of hot 10% gelatin in a test-tube; after setting, the gel is covered with 10 ml. of 0.2M-aq. NH_3 , and set aside.

L. S. T.

VI.—KINETIC THEORY. THERMODYNAMICS.

Equilibrium constant equation. W. A. Dow (*J. Chem. Educ.*, 1940, 17, 439—440).—A theoretical demonstration.

L. S. T.

Ethane-ethylene-hydrogen equilibrium. E. A. Guggenheim (*Trans. Faraday Soc.*, 1941, 37, 97—105).—The equilibrium const. K_p for the reaction $C_2H_4 + H_2 \rightleftharpoons C_2H_6$ is calc. by the methods of statistical mechanics from spectroscopic and thermal data. The calc. vals. agree completely with

3 out of 4 sets of experimental data over the range 673 — $973^\circ K$. Formulae are given for K_p over the same range.

F. L. U.

Effect of solvation on the dissociation of acetone cyanohydrin. T. D. Stewart and B. J. Fontana (*J. Amer. Chem. Soc.*, 1940, 62, 3281—3285).—The dissociation $OH \cdot CMe_2 \cdot CN(I) \rightleftharpoons COMe_2 + HCN$ is catalysed by amines in all solvents. The reaction is immeasurably rapid in H_2O and the lower alcohols, measurable in Bu^oOH , CCl_4 , C_6H_6 , and $CHCl_3$, and extremely slow in dioxan. In the presence of amine, the degree of dissociation is (a) increased in H_2O because of possible formation of an amine-HCN complex (II), (b) totally unaffected in nine different alcohols for which there is little evidence for the formation of (II), and (c) decreased in CCl_4 , C_6H_6 , $CHCl_3$, and dioxan, probably owing to formation of a cyanohydrin-amine complex which more than compensates for any formation of (II) (cf. A., 1938, I, 81). The pure solvents with or without a trace of catalyst affect the rates and equilibria of dissociation in a manner which can be correlated with their capacities to form H bond complexes and to act as proton donors. The heats of dissociation of (I) in H_2O , $EtOH$, C_6H_6 , and $CHCl_3$ are calc. and vary from 8400 to 10,400 g.-cal. per mol.

W. R. A.

Constitution of alkaline-earth aluminate solutions. G. Maekawa and T. Arimori (*J. Soc. Chem. Ind. Japan*, 1940, 43, 315b).—Vals. of p_H for Ca aluminate solutions have been determined, and compared with those for solutions of $Ca(OH)_2$ so as to find the concn. of free $Ca(OH)_2$. In this way the ratio (combined CaO)/ $[Al_2O_3]$ is shown to be ~ 1 , so that the solutions contain salts of $HAIO_2$. Similar results were obtained for Sr and Ba aluminate solutions.

F. J. G.

Dissociation constant of hypochlorous acid. G. Holst (*Svensk Kem. Tidskr.*, 1940, 52, 258—261).—The p_H of chloride-free $NaOH$ - $HOCl$ mixtures has been determined at 25° with the glass electrode, $[HOCl]$ being determined by $I-Na_2S_2O_3$. Const. vals. of K are calc. for the p_H range 4—9, giving $K_{25} = 6.8 \times 10^{-8}$.

M. H. M. A.

Thermodynamic study of bivalent metal halides in aqueous solution. VII. Activity coefficient of barium bromide at 25° . R. A. Robinson (*Trans. Faraday Soc.*, 1941, 37, 82—84; cf. A., 1940, I, 359).—Osmotic and activity coeffs. determined by the isopiestic method are tabulated for $BaBr_2$ over the range 0.1—2.4M. The γ -concn. curve is considerably higher than that for $BaCl_2$, and no reversal in order of the chloride and bromide occurs as it does with Rb and Cs salts.

F. L. U.

Physicochemical studies on the alkali carbonates. II. Calculation of activity coefficients of sodium and potassium carbonates in aqueous solution. L. Lortie and P. Demers (*Canad. J. Res.*, 1940, 18, B, 373—385).—The usual equation for calculating the mean activity coeff. (γ) of an electrolyte from the depression of the f.p. (θ) has been modified so as to take account of the variation of the no. (ν) of ions per mol. resulting from hydrolysis or from secondary ionisation; the modification requires the assumption that the individual activity coeffs. of the ions are all equal. The modified equation

is $\log \gamma_\theta = -j/2.3026 - \int_0^M j d \log \nu M + b \int_0^M (\theta/\nu M) d\theta$, where

M = concn., $b = 0.00025$, $j = 1 - \theta/\nu M$, and $\lambda = 1.858$ and where ν is a variable function of M and θ . Using this equation, vals. of γ for K_2CO_3 and Na_2CO_3 have been computed. At each concn. γ for K_2CO_3 is > for Na_2CO_3 . At high dilution the curves approach the limiting law for uni-univalent rather than that for uni-bivalent salts.

F. J. G.

Changes in chemical equilibria in liquid interfaces. G. J. Szasz (*J. Amer. Chem. Soc.*, 1940, 62, 3520—3521).—An unsuccessful attempt has been made to explain the colour changes produced when an aq. solution of a dye is shaken with equal vols. of an immiscible liquid (cf. Deutsch, A., 1928, 1183). Various concns. of dye were employed at a given p_H and the concn. at which the most pronounced colour change occurred has been determined for 5 dyes. Me-violet in 0.1N-HCl changes from blue to purple. Tropæoline OO gives a distinct colour change in the foam at p_H 2.28, but not in the liquid phases. Data are given for malachite-green base in 0.4N-HCl, brilliant-green base in 0.25N-HCl, bromothymol-blue in H_2O , thymolsulphonethalein in 0.0016N-HCl, and rhodamine O in C_6H_6 .

W. R. A.

Iodine monochloride. III. Systems iodine monochloride-acetic acid and iodine monochloride-carbon tetrachloride. J. Cornog and L. E. Olson (*J. Amer. Chem. Soc.*, 1940, **62**, 3328—3330).—The ICl-AcOH system is of the simple binary type with a eutectic at -35° containing 60 mol.-% of AcOH. ICl-CCl₄ forms a series of solid solutions. The liquidus curve is S-shaped. A eutectic point occurs at -26.4° and of 98.2 mol.-% of CCl₄ between solid solutions and another solid phase of undetermined composition. A metastable double layer liquid system is also found with crit. temp. $\sim 14^\circ$. The f.p. of ICl is 27.3° , i.e., $0.1^\circ >$ the accepted val.

W. R. A.

B.p.-composition diagram of immiscible and partly miscible liquid systems. M. Randall and W. Avila (*J. Chem. Educ.*, 1940, **17**, 536—537).—Diagrams for the systems C₆H₆-H₂O and NH₃-Ph-H₂O are reproduced and discussed.

L. S. T.

Solubility product. Demonstration introducing the common ion effect and formation of complex ions. S. Zuffanti (*J. Chem. Educ.*, 1940, **17**, 433).—The use of AgOAc for this purpose is described.

L. S. T.

Effect on the solubility of precipitates of ions of the same charge in absence of a common ion. R. N. Golovati (*J. Appl. Chem. Russ.*, 1940, **13**, 586—591).—At 18 – 20° the solubility of PbI₂ is min. in 0.01N-KI, and is raised by KNO₃ or Ca(NO₃)₂, to an extent \propto their concn.; at the same time the [KI] at which solubility is least rises. Analogous results are obtained for the systems PbF₂-KF-KNO₃ and PbSO₄-K₂SO₄-KNO₃. The solubility of CaSO₄ is min. in 0.08N-K₂SO₄; in presence of 0.01–0.1N-HNO₃ it is higher, but falls with increasing [K₂SO₄], whilst in 0.1N-KOH it rises. The solubility of PbSO₄ is least at $p_H \approx 7$; it falls with increasing [K₂SO₄] at $p_H < 7$, and rises at $p_H > 7$. The effect of a common ion is to depress solubility in absence of complex formation; where complexes are formed the action of salts not having a common ion is unpredictable, and depends largely on the properties of the complex.

R. T.

Solubility of salts in acids. P. A. Epik (*J. Appl. Chem. Russ.*, 1940, **13**, 857—865).—Tananaev's formulæ (A., 1937, **1**, 135) are based on erroneous assumptions, and are not valid. Those of Babko (A., 1936, **41**) are applicable to appropriate cases. Formulæ for calculation of solubility of ppts. of the type M_mA_n, in presence and absence of excess of H, M, or A ions, are derived.

R. T.

Ternary systems ZnSO₄-H₂SO₄-H₂O from -5° to 70° and ZnO-SO₃-H₂O at 25° . L. C. Copeland and O. A. Short (*J. Amer. Chem. Soc.*, 1940, **62**, 3285—3291).—The system ZnSO₄-H₂SO₄-H₂O has been investigated over the temp. range -5° to 70° and from 0 to 60% H₂SO₄, and at 25° up to 97% H₂SO₄. Trilinear plots at 15° , 25° , and 45° are presented. A three-dimensional model over the temp. range -4.5° to 65° is given, the projection of the model on the 0% H₂SO₄ face showing the solubility of ZnSO₄ in H₂O and the variation of the four-phase systems (two solid, one liquid, and one vapour) with temp. By extrapolation it is shown that at 21° a quintuple point exists where ZnSO₄·xH₂O ($x = 7, 6$, and 1) are in equilibrium with saturated ZnSO₄ solution (ZnSO₄ 21.5%, H₂SO₄ 23.5%) and vapour. Isothermal invariant points for ZnSO₄·7H₂O = ZnSO₄·6H₂O + H₂O and ZnSO₄·6H₂O = ZnSO₄ + 5H₂O exist at 39° and 60° , respectively, the data for 21° and 39° being substantiated by v.p. and decomp. pressure measurements. At 25° and up to 97% H₂SO₄ anhyd. ZnSO₄ exists and possibly ZnSO₄·H₂SO₄. The study of the system ZnO-SO₃-H₂O at 25° indicates that the solid phase in equilibrium with the ZnSO₄ solution is a basic salt and is represented as 3Zn(OH)₂·ZnSO₄·4H₂O. The results obtained are compared with existing data.

W. R. A.

Sulphuric acid treatment of phosphates. IV. System CaSO₄-H₃PO₄-H₂O. A. A. Taperova (*J. Appl. Chem. Russ.*, 1940, **13**, 643—652).—At 25° the stability of various cryst. forms of CaSO₄ varies according to the [H₃PO₄], in the orders CaSO₄·0.5H₂O (I) < anhydrite (II) < gypsum (III) at [P₂O₅] < 33.75%. (I) < (III) < (II) at [P₂O₅] 33.75–49%, and (III) < (I) < (II) at [P₂O₅] > 49%. At 80° (II) is the sole stable phase.

R. T.

Bunsen's salt. H. Irving and G. W. Cherry (*J.C.S.*, 1941, 25—30).—The only double compound occurring in the system NH₄Cl-(NH₄)₂Fe(CN)₆-H₂O at 25° or 40° is Bunsen's salt, 2NH₄Cl·(NH₄)₂Fe(CN)₆ (I). The existence of a tri-

hydrate (Hölzl, *Sitzungsber. Akad. Wien*, 1928, **137**, 116, 1110) could not be confirmed. The grounds for Hölzl's formulation of (I) as containing 8-covalent Fe are false, as the defects which he observed in the linearity of the conductivity with the mol. ratio in this system are predicted on general grounds. X-Ray examination indicates that the hexagonal unit cell of (I) has a_0 9.24, c_0 18.92 Å. The Fe-Cl distance is ~ 6 Å., thus precluding the possibility of a covalent link between these atoms.

J. W. S.

Carbamide. IV. System carbamide-gypsum-water. W. Sakai (*J. Soc. Chem. Ind. Japan*, 1940, **43**, 318—319b).—When gypsum is heated at 80° with CO(NH₂)₂ (I), the yield of CaSO₄·4(I) increases with increasing humidity, the presence of adsorbed H₂O being necessary for reaction. The 25° and 30° isotherms of the system CaSO₄-(I)-H₂O are given. At 30° a solution in equilibrium with CaSO₄·4(I) is nearly saturated with (I), so that to prepare CaSO₄·4(I) through the solution phase it is necessary to cool a solution saturated at a higher temp.

F. J. G.

Calorimetric investigations of organic reactions. II. A new calorimeter. Mutarotation of α - and β -D-glucose. J. M. Sturtevant (*J. Physical Chem.*, 1941, **45**, 127—147).—An adiabatic calorimeter particularly suitable for heat measurements in very rapid reactions and for reactions where the heat changes are slight is described. Errors in temp. measurement and in timing, and errors due to lag and other causes, are discussed. The use of the instrument in the measurement of the mutarotation of α - and β -D-glucose at 25° and 35° has shown that the heat change accompanying α (solid) $\rightarrow \beta$ (solid) is 4874 and 4955 joules per mol. at the two temp. respectively, the heat change vals. for each step at the same temp. being α (solid) $\rightarrow \alpha$ (aq.) 10,716, 12,222; α (aq.) $\rightarrow \beta$ (aq.) -1162, -1282; β (aq.) $\rightarrow \beta$ (solid) -4680, -6015 joules per mol. The ratio of the two equilibrium consts. $K_{35}/K_{25} = 1.595/1.677 = 0.949$. The theoretical val. for the ratio is 3.7% higher, a discrepancy sufficiently large to suggest that additional forms of glucose are involved. The data of other investigators support this view.

C. R. H.

Heats of dilution of amino-acids. J. M. Sturtevant (*J. Amer. Chem. Soc.*, 1940, **62**, 3519—3520).—An aq. solution of an NH₂-acid contains only zwitterions if the solution is conc. On dilution some zwitterions will change to positive and negative ions and H₂O will dissociate. The thermal effects thus produced should be subtracted from the observed heat of dilution of NH₂-acids in order to obtain the true heat of dilution of zwitterions. Equations are developed which, in conjunction with data for glycine, yield a val. of 20 joules per mol. for the ionisation heat effect, of which ~ 15 joules per mol. are accounted for in changes occurring between 10^{-2} and 10^{-4} M.

W. R. A.

Entropy of dilution of strong electrolytes in aqueous solutions. H. S. Frank and A. L. Robinson (*J. Chem. Physics*, 1940, **8**, 933—938).—The relative partial mol. entropy of H₂O in aq. solutions of various salts is calc. from the relative partial mol. heat content of the H₂O and its activity, and is correlated with changes in the structure of H₂O in the solutions. Cations of small radii and ions capable of forming H-bonds with the H₂O (H₃O⁺, OH⁻, and NH₄⁺) stabilise the H₂O structure, whilst large ions and ions of non-spherical and non-tetrahedral shapes have the reverse effect. In dil. solution the entropy of dilution depends largely on the ionic strength. In all cases deviations from the Debye-Hückel limiting law are positive.

J. W. S.

VII.—ELECTROCHEMISTRY.

Sign of electrode potential. C. S. Hoyt (*J. Chem. Educ.*, 1940, **17**, 530—532).—A convention for the sign of the potential of a galvanic cell based on free energy changes at the electrodes is presented. It is independent of the direction of current flow, and applies uniformly to all cases. Examples of its application are quoted.

L. S. T.

Potential of the Yb^{III}-Yb^{II} electrode. G. C. Walters and D. W. Pearce (*J. Amer. Chem. Soc.*, 1940, **62**, 3330—3332).—Aq. Yb(OAc)₃ was reduced electrolytically to the extent of $\sim 82\%$ and the product was used in the cell Pt|Yb^{III}, Yb^{II}, AcOH, N-KCl|N-KCl|N-KCl, Hg₂Cl₂|Hg, the e.m.f. of which was measured at different Yb^{III}/Yb^{II} ratios. The oxidation-reduction potential (E_0) is 0.578 v., a val. high compared with

0.43 v. for E_0 of $\text{Eu}^{III}-\text{Eu}^{II}$ (cf. McCoy, A., 1936, 1347). The lanthanide contraction creates greater stability in atoms in the normal trivalent state and is reflected in the magnitude of E_0 . It is predicted that Tm^{III} will be more unstable than Sm^{III} which will be more unstable than Yb^{III} or, in other words, E_0 for $\text{Tm}^{III}-\text{Tm}^{II} > \text{Sm}^{III}-\text{Sm}^{II} > \text{Yb}^{III}-\text{Yb}^{II}$.

W. R. A.
Mechanism of the glass electrode. G. Haugaard (*J. Physical Chem.*, 1941, 45, 148—157).—Conductivity experiments with glass electrodes have been made in conditions under which the electrodes normally operate. Na^+ are quantitatively responsible for the transference. They are displaced by H^+ which have a lower conductance. The potential of new glass surfaces in H_2O decreases with time, the val. at a given time having a linear relation to the log of the amount of H^+ adsorbed per unit area. The slope of the curve has a val. close to the val., 59.1 mv. at 25°, of the factor $RT/F \log e$ in the Nernst equation. H^+ adsorbed in the glass appear to be solvated to the extent of 0.5 mol. of H_2O per H^+ . Glass takes up both H_2O and EtOH from $\text{EtOH}-\text{H}_2\text{O}$ mixtures. It is suggested that Na_2SiO_3 is hydrolysed at the surface to form a skeleton of H_2SiO_3 in the surface layer. H^+ react with this surface and gain entrance to the glass. In the interior of the glass is a layer of unhydrolysed Na_2SiO_3 which moves to one side or another depending on the direction of the current.
C. R. H.

Oxidation potentials of ketones and an aldehyde. R. H. Baker and H. Adkins (*J. Amer. Chem. Soc.*, 1940, 62, 3305—3314).—The method of establishing [by $\text{Al}(\text{O}i\text{Bu})_3$ —3314].—The method of establishing [by $\text{Al}(\text{O}i\text{Bu})_3$ —3314] and measuring the equilibrium $\text{CORR} + \text{CHR}'\text{R}'''\text{OH} \rightleftharpoons \text{CHRR}'\text{OH} + \text{COR}'\text{R}'''$ (Cox *et al.*, A., 1940, II, 90) is improved and the reversibility of the reaction is confirmed. Results are recorded for 23 ketones, 1 aldehyde, and 6 quinones. Fluorenone is used as standard because of its rapid rate of reaction. The rate of this reaction and the depolarisation potential at a dropping Hg cathode are not related to the relative reactivities. The results are used to calculate oxidation potentials. Unsaturation has little effect on the reactivity of a ketone. The high reactivity of $p\text{-O}_2\text{C}_6\text{H}_4\text{O}$ is due to the ready rearrangement of the primary reduction product to quinol.
R. S. C.

Redox titrations of vat dye systems.—See B., 1941, II, 76.

VIII.—REACTIONS.

Temperature and latent energy in flame gases. W. T. David (*Nature*, 1941, 147, 89).—Additional experiments supporting the view that the temp. of the flame gases resulting from the combustion of an inflammable gaseous mixture increases, and the contained latent energy decreases, as the distances of flame travel from the igniting spark increases are discussed. They suggest also that this is because the mechanism of combustion in the early stages after spark ignition differs from that in the later stages.
L. S. T.

Latent energy and dissociation in flame gases. W. T. David, A. S. Leah, and B. Pugh (*Phil. Mag.*, 1941, [viii], 31, 156—168).—Pressures < vals. calc. from thermal data, developed in CO -air explosions, are explained by postulating long-lived latent energy in the form of excess internal energy of the CO_2 mols. formed. The discrepancy between actual and theoretical flame temp. decreases with increasing distance of flame travel; it decreases when H_2 is mixed with the CO . The latent energy is emitted as after-glow and in contact with surfaces. Temp. measurements in explosions give higher vals. using a bare Pt-Rh wire than when a Pt-Rh wire coated with quartz is used, and the temp. is a max. for a lower percentage of CO in the mixture in the former case. This indicates abnormally high dissociation of CO_2 in the flame, recombination occurring on the bare wire, but not on the coated one.
L. J. J.

Radiation of the low-temperature flame of carbon disulphide. V. Kondratiev (*Acta Physicochim. U.R.S.S.*, 1940, 12, 637—646).—The dependence on the composition of the CS_2-O_2 mixture, and on temp., of the light output (i) of the low-temp. flame of CS_2 has been studied. With increasing $[\text{O}_2]$, i rises to a sharp max. at $[\text{O}_2]/[\text{CS}_2] \sim 6$ and then falls sharply, but without any abrupt change of reaction rate, so that a change in the reaction mechanism is probable. With rising temp. i decreases. The max. val. of i corresponds with evolution

of one quantum for ~ 40 mols. reacting. The radiation is purely chemiluminescent.
F. J. G.

Surface as a limiting factor in the slow combustion of hydrocarbons. R. G. W. Norrish and J. D. Reagh (*Proc. Roy. Soc.*, 1940, A, 176, 429—448).—Rates of combustion of several hydrocarbons, both saturated and unsaturated, were determined in reaction vessels of widely varying diameter but approx. const. volume. When the diameter of the reaction vessel was sufficiently reduced the reaction rate fell to zero and the induction period increased towards infinity. In narrow vessels surface deactivation can predominate over other processes of deactivation, whilst in wider vessels surface and vol. deactivation occur to a comparable extent over a considerable range of pressure.
G. D. P.

Relationship between initial conditions and pressure increase at explosion [of gas mixtures]. N. V. Tokarev and N. I. Nekrasov (*Acta Physicochim. U.R.S.S.*, 1940, 12, 573—588; cf. A., 1937, I, 247).—For NH_3-O_2 , NH_3 -air, and $\text{H}_2-\text{N}_2-\text{O}_2$ mixtures there is a linear relationship between the pressure increase Δp occurring when the mixture is exploded by a spark and its initial pressure, and between Δp and the initial temp. The straight lines representing these relations for any given mixture meet at a point where $\Delta p = 0$ and the initial pressure or temp. is that characteristic of the spontaneous inflammation of the mixture. Thus the vals. characterising spontaneous ignition can be approx. calc. from those characterising spark ignition.
F. L. U.

Spontaneous inflammability of phosphine- and silane-acetylene mixtures.—See B., 1941, I, 94.

Reaction of methane with steam. II. Velocity of the reaction. A. Leibusch and G. Berge (*J. Appl. Chem. Russ.*, 1940, 13, 1003—1013).—At 700—1050°, in SiO_2 reactors, CH_4 yields CH_2 , C_2H_2 , C_2H_4 , C_2H_6 , and C; all these products react with H_2O to give CO and H_2 . In the initial stages the velocity of the process is determined by that of the reactions $\text{CH}_4 \rightleftharpoons \text{CH}_2 + \text{H}_2$ (i) and $\text{CH}_2 + \text{H}_2\text{O} \rightleftharpoons 2\text{H}_2 + \text{CO}$. With increasing $[\text{H}_2]$ reaction (i) is reversed, and the dominating reaction then becomes $\text{CH}_4 + \text{H}_2\text{O} \rightarrow 3\text{H}_2 + \text{CO}$.
R. T.

Kinetics of thermal isomerisation of trans-dichloroethylene. J. L. Jones and R. L. Taylor (*J. Amer. Chem. Soc.*, 1940, 62, 3480—3485).—Thermal isomerisation of gaseous trans- $\text{C}_2\text{H}_2\text{Cl}_2$ into the cis-form has been studied in the temp. range 566—608° K. from 200 to 700 mm. The reaction is homogeneous of the first order, and with activation energy 41,900 g.-cal. which is considered to be localised in the internal degrees of freedom of the double bond and almost independent of the nature of the attached atoms. The isomerisation is thought to occur by the activation of the C:C double bond to form a single bond with two free valencies. Free rotation of the H-C-Cl groups takes place and a double bond is re-formed in the cis-mol. by an inversion of a free C valency. The activation energy compares favourably with those of the Me cinnamate and isostilbene isomerisations, and it is concluded that the reaction is almost independent of resonance effects.
W. R. A.

Kinetics of the thermal decomposition of acetophenone. R. E. Smith and C. N. Hinshelwood (*Proc. Roy. Soc.*, 1940, A, 176, 468—473).—The reaction takes place predominantly by the step $\text{COPhMe} = \text{PhMe} + \text{CO}$, the PhMe undergoing a subsequent decomp. to C_6H_6 , CH_4 , and C. It differs from that of COMe_2 in yielding hardly any ketone. There is no retardation of the reaction by NO or by greatly increased surface, nor can an increased rate of reaction be induced by the presence of radicals from decomp. Et_2O . This indicates the absence of reaction chains. The contrast in behaviour between MeCHO and PhCHO is not found with the corresponding pair COMe_2 and COPhMe .
G. D. P.

Homogeneous first-order gas reactions. XII. Decomposition of glyoxal tetra-acetate. J. C. Arnell, J. R. Dacey, and C. C. Coffin (*Canad. J. Res.*, 1940, 18, B, 410—413).—The decomp. of glyoxal tetra-acetate at 538—583° and at 4—40 cm. is homogeneous and unimol., with $k = 1.8 \times 10^{12} e^{-39,000/RT}$.
F. J. G.

Chain reactions in aqueous solutions containing ozone, hydrogen peroxide, and acid. H. Taube and W. C. Bray (*J. Amer. Chem. Soc.*, 1940, 62, 3357—3373).—The interaction of O_3 and H_2O_2 in acid solution involves the reactions $\text{H}_2\text{O}_2 + \text{O}_3 = \text{H}_2\text{O} + 2\text{O}_2$ (A) and $2\text{O}_3 = 3\text{O}_2$, (B) (A., 1938, I, 147), both

of which are chain reactions. Both reactions are inhibited by Cl^- ions, aliphatic acids (except HCO_2H) and alcohols; (A) is also inhibited by Br^- ions. The effects produced by varying the concn. of Cl^- ions or of AcOH in HClO_4 , HNO_3 , and H_2SO_4 solutions have been investigated at approx. const. concns. of O_3 , H_2O_2 , and acid. The rates of both reactions in presence of the inhibitor in acid solution (0.1 — 0.4M-H^+) at 0° are represented by differential equations. The chain reactions involve HO and HO_2 radicals which are formed in the bimol. reaction between O_3 and H_2O_2 . HO reacts with O_3 , H_2O_2 , the inhibitors, and the acid anions (SO_4^{--} , NO_3^- , and ClO_4^-) but only O_3 reacts with HO_2 . When AcOH is the inhibitor org. free radicals are formed and react with O_3 but not with H_2O_2 . Cl^- ions give rise to Cl atoms which react more readily with H_2O_2 than with O_3 . The predicted mechanism is: $\text{H}_2\text{O}_2 + \text{O}_3 \rightarrow \text{HO} + \text{HO}_2 + \text{O}_2$; $\text{HO}_2 + \text{O}_3 \rightarrow \text{HO} + 2\text{O}_2$; $\text{HO} + \text{O}_3 \rightarrow \text{HO}_2 + \text{O}_2$; $\text{HO} + \text{H}_2\text{O}_2 \rightarrow \text{HO}_2 + \text{H}_2\text{O}$; $\text{HO} + \text{inhibitor} \rightarrow \text{radical} + \text{HO}_2$. The rates of reaction of HO with $\text{Cl}^- > \text{O}_3 > \text{H}_2\text{O} > \text{AcOH}$ in 0.19M-H^+ solution. The equilibrium $\text{Cl} + \text{Cl}^- = \text{Cl}_2^-$ has been detected. The reactions are catalysed by Ce^{+++} , Pr^{+++} , Co^{++} , Cu^+ , Ag^+ , and Ti^+ ions and by HCO_2H . The rate of decomp. of O_3 is greatly increased when O_3 oxidises Co^{++} or Ce^{+++} ions or HCO_2H , which supports the view that HO and HO_2 radicals are intermediate products of both reactions.

W. R. A.

Quantitative study of the so-called "positive halogen" in ketones and esters.—See A., 1941, II, 67.

Velocity of reduction of phenols. I. Monohydric phenols.—See A., 1941, II, 94.

Rates of reaction of stereoisomeric oximes of cholestenone and of benzylidene-*p*-bromoacetophenone with iodine monobromide. J. O. Ralls (*J. Amer. Chem. Soc.*, 1940, 62, 3485—3488).—The bromination of benzylidene-*p*-bromoacetophenone (I) and cholestenone (II) and their *anti*- and *syn*-forms of oximes, in CCl_4 , AcOH , and CCl_4 - AcOH solutions, with IBr , and the effect of direct bromination of oximes of (II) have been investigated. In CCl_4 the *anti*-form of the oximes is slightly more reactive than the *syn*-, whilst in pure AcOH and CCl_4 - AcOH mixtures a marked depression in the bromination of (I) and its oximes and of the oximes of (II), but an acceleration of that of (II), was observed. The easy enolisation of (II) as compared with (I) is considered to account for the observed acceleration. In the direct bromination of the oximes of (II), the *anti*-form is more reactive than the *syn*-.

W. R. A.

Kinetics of reactions in heterogeneous systems. VI. Hydrolysis of acid halides by water. K. K. Dole (*J. Univ. Bombay*, 1940, 9, Part 3, 76—93; cf. A., 1939, I, 270).—The addition of org. acid increases the velocity coeff. (k) of the hydrolysis of $\text{o-C}_6\text{H}_4(\text{CO}_2\text{H})_2$ (I) at the interface between PhCl and H_2O , the increase being approx. \propto the concn. of the acid. Addition of Na_2SO_4 decreases k for (I) or $\text{m-NO}_2\text{-C}_6\text{H}_4\text{-COCl}$ (II), this effect being attributed to a decrease in the solubility of the acid in H_2O , and consequent passage of the acid into the PhCl , where it is adsorbed in the interface, displacing acid chloride mols. and decreasing their concn. in the reaction zone. The rate of hydrolysis of an old PhCl solution of (I), when brought into contact with H_2O , is $>$ for a fresh solution, owing to the slow hydrolysis by H_2O from the air yielding the acid. With $\text{o-C}_6\text{H}_4\text{-COCl}$ k decreases gradually for an old solution, but for a fresh solution it increases to a max. and then decreases. This is attributed to the lower solubility in H_2O of $\text{o-C}_6\text{H}_4\text{-CO}_2\text{H}$, causing it to pass into the PhCl phase and to be adsorbed in the interface. Temp. coeff. measurements indicate that the reactions are composite, and that their courses are affected by both diffusion and adsorption phenomena. Except in the case of (II) the temp. coeffs. are increased by the addition of Na_2SO_4 .

J. W. S.

Catalytic oxidation of phosphorus tribromide. C. R. Johnson and L. G. Nunn, jun. (*J. Amer. Chem. Soc.*, 1941, 63, 141—143).—The oxidation of PBr_3 vapour by O_2 to POBr_3 at O_2 pressures from 150 to 700 mm. at temp. between 30° and 150° in the presence of N oxides takes place rapidly and non-explosively. It is catalysed by N_2O_4 but not by NO_2 and at $<100^\circ$ the velocity coeffs. at const. temp. \propto pressure of N_2O_4 . Oxidation also $\propto [\text{O}_2 \text{ pressure}]^{\frac{1}{2}}$.

W. R. A.

Oxidation-reduction reaction catalysed by iodine. Application to the detection of iodide. D. Hart and R. Meyrowitz

(*Ind. Eng. Chem. [Anal.]*, 1940, 12, 774—775).—In presence of I^+ , addition of NO_2^- to a dil. HNO_3 solution of Pb arsenite ppts. PbHAsO_4 (I). This reaction forms the basis of a test for $<0.2 \mu\text{g.}$ of I^+ . Directions for using this as a drop reaction or on the macro-scale, and a modification in which Ag_3AsO_4 is pptd. instead of (I), are given. Sn^{++} , Sn^{+++} , Fe^{++} , V , CNS^- , ClO_3^- , MnO_4^- , IO_3^- , BrO_3^- , IO_4^- , $\text{S}_2\text{O}_3^{--}$, and H_2O_2 give ppts. in absence of I^+ , and with Cr^{+++} , Ag^+ , Hg^+ , Hg^{++} , Fe^{+++} , Be^{++} , Ir , Ru , F^- , CN^- , S^- , and $\text{S}_2\text{O}_8^{--}$ no ppt. is obtained in presence or absence of I^+ . A procedure which uses a Na_2CO_3 extract and detects $0.03 \mu\text{g.}$ of I^+ in presence of 50 mg. of interfering ions other than those of Hg , Ag , IO_3^- , IO_4^- , MnO_4^- , $\text{S}_2\text{O}_8^{--}$, Au , Ir , and Ru , and H_2O_2 is described. Many other ions that do not interfere with the test are listed.

L. S. T.

Relation between the oxidising action and catalytic decomposition of concentrated hydrogen peroxide. I. Osmium tetroxide as a catalyst in the oxidation of acetic and propionic acids. L. M. Foster and J. H. Payne (*J. Amer. Chem. Soc.*, 1941, 63, 223—225).— AcOH and EtCO_2H have been oxidised by 60% H_2O_2 catalysed by OsO_4 and the amount of oxidation, indicated by the amount of CO_2 , and the decomp. of H_2O_2 , indicated by the amount of O_2 evolved, have been determined simultaneously. The oxidation of EtCO_2H increases rapidly with increased amounts of OsO_4 , whereas AcOH is influenced to a smaller extent. The decomp. of H_2O_2 is also catalysed by OsO_4 .

W. R. A.

Poisoning of a palladium catalyst by carbon monoxide. M. G. T. Burrows and W. H. Stockmayer (*Proc. Roy. Soc.*, 1940, A, 176, 474—483).—Very small amounts of CO completely inhibit the combination of H_2 and O_2 at the surface of a Pd catalyst at low pressures and room temp. The poisoning effect is only temporary, the adsorbed layer of CO being removed by the O_2 in the mixture of H_2 and O_2 . After an induction period combination proceeds at the normal rate. The length of the inert periods increases with the amount of CO in the system, and the rate of removal of CO increases as its pressure decreases, becoming comparatively great when the CO is insufficient to form a monolayer. The observations support the view that the catalysis is a process of alternate oxidation and reduction of the metal.

G. D. P.

Oxidation of sulphur dioxide at activated vanadium catalysts. II. Effect of alkali-metal salts and silicic acid on the catalytic activity of vanadium pentoxide. G. K. Boreskov and V. P. Pligunov (*J. Appl. Chem. Russ.*, 1940, 13, 653—662; cf. B., 1940, 736).— VOSO_4 is not formed when SO_2 - O_2 is passed over V_2O_5 at 420 — 520° . The activation energy E of the reaction $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$ is 38 kg.-cal. Addition of SiO_2 to the V_2O_5 lowers its activity. That of $1:10 \text{ K}_2\text{SO}_4$ - V_2O_5 in ten times that of V_2O_5 alone, at 500° , but is considerably smaller at $<490^\circ$ or at 520° ; at the latter temp. conversion into VOSO_4 proceeds rapidly. At 500° olive-green crystals of a substance containing K_2O , V_2O_5 , or V_2O_4 , and SO_3 appear. $1:10:80 \text{ K}_2\text{SO}_4$ - V_2O_5 - SiO_2 mixtures are extremely active catalysts, being 20 times as active as V_2O_5 alone at 440 — 500° , and twice as active at 400° ; the apparent E is 27 kg.-cal.

R. T.

Reaction between nitrous oxide and hydrogen on alumina. J. E. Vance and J. K. Dixon (*J. Amer. Chem. Soc.*, 1941, 62, 176—181; cf. A., 1935, 829).—Rates and amounts of adsorption for H_2 and N_2O from 0° to 400° and the reaction between N_2O and H_2 at 330° , 403° , and 472° have been investigated on Al_2O_3 in a flowing system, the extent of the reaction being limited to $\sim 10\%$ at the highest temp. N_2O was adsorbed reversibly and instantaneously up to 250° , when it began to decompose at a rate \propto its pressure, the rate being reduced 25-fold by saturation of the Al_2O_3 with H_2O . Adsorption of H_2 was reversible and instantaneously up to 250° , when a slow activated adsorption became measurable. Between 300° and 400° , there appears to be a rapid initial adsorption followed by a very slow process, both of which are initially affected by addition of a small amount of H_2O vapour. The average measured rate of adsorption in the first 15 min. is 2700 times $<$ the rate of reaction with N_2O and suggests that N_2O cleans up the most active surface for adsorption of H_2 at the rapid rate which is required to maintain the observed reaction velocity. The rate of decomp. of N_2O alone is 850 times $<$ the rate of reaction with H_2 . The rate of H_2O formation in the H_2 - O reaction $\propto [\text{N}_2\text{O pressure}]^{\frac{1}{2}}$ and \propto a fractional power of the H_2 pressure, which varied from 0.66 at 333° to 0.33 at 472° . Kinetic study suggests that part of

the reaction takes place on an unhydrated Al_2O_3 surface inhibited by H_2O and the remainder on a completely hydrated surface uninhibited by H_2O , the apparent activation energies on the two surfaces being 30.0 and 35.7 kg.-cal. per mol., respectively; the difference is attributed partly to the heat of adsorption of H_2O . The apparent activation energies of N_2O on Pt, Au, CuO, MgO, and CuO-MgO, and of the N_2O - H_2 reaction on Ag and Pt, are compared and shown to be of same order, except on Ag. The activity of Al_2O_3 in the dehydrogenation of hydrocarbons is briefly discussed. W. R. A.

Chromic oxide as a catalyst in potassium chlorate decomposition. M. Meyer (*J. Chem. Educ.*, 1940, 17, 494).— Cr_2O_3 (1–5%), or $\text{K}_2\text{Cr}_2\text{O}_7$, is the most efficient catalyst for the thermal decomp. of KClO_3 . Some Cl_2 contaminates the O_2 involved. L. S. T.

Charcoal catalyst for conversion of carbon monoxide.—See B., 1941, I, 99.

Electrolytic preparation of cerium amalgam. S. I. Skljarenko and B. A. Sacharov (*J. Appl. Chem. Russ.*, 1940, 13, 841–845).—Electrolysis of CeCl_3 in MeOH, EtOH, or MeOH-EtOH (Hg cathode, c.d. 0.05 amp. per sq. cm., at 30–40°) yields 0.5–1.2% Ce amalgams. R. T.

Electrolytic reduction of ferric sulphate in presence of titanium sulphate. IV. Nature of cathode polarisation. K. J. Gratshev (*J. Appl. Chem. Russ.*, 1940, 13, 516–520; cf. A., 1939, I, 480).—In electrolysis of aq. $\text{FeSO}_4\text{--Fe}_2(\text{SO}_4)_3$ at 20–50° (Pb anode, Cu cathode) only concentrational polarisation of the cathode is observed at c.d. < the limiting val. Polarisation is considerable with Pb cathodes at such c.d., owing to formation of a film at the metal surface. At c.d. > the limiting val. the polarisation potential at Pb is > at Cu cathodes as a result of the higher H overpotential on Pb. R. T.

Electrode polarisation in electrolytic preparation of potassium ferriocyanide. O. Essin, S. Derendjajev, and N. Ladigin (*J. Appl. Chem. Russ.*, 1940, 13, 971–977).—In the electrolytic oxidation of $\text{K}_3\text{Fe}(\text{CN})_6$ to $\text{K}_3\text{Fe}(\text{CN})_6$, cathode polarisation is due entirely to concentrational factors, and is the same with Pt as with Ni electrodes. It is greatly diminished by stirring the electrolyte. R. T.

Recovery of cobalt from solutions of its sulphate by electrolysis.—See B., 1941, I, 111.

Replacement of cyanide in electrolytic baths.—See B., 1941, I, 109.

Production of ozone in the silent electric discharge. W. H. Otto and W. H. Bennett (*J. Chem. Physics*, 1940, 8, 899–903).—The rate of formation (ν) of O_3 in a silent electric discharge with a 0.005-in. W wire as internal electrode is > with a 0.001-in. W wire. In each case the metal is oxidised. This action is prevented by using a 0.001-in. Rh-plated Ni wire, but the yield is reduced. With d.c., ν is greatest when the inner electrode is negative, the difference being greater for the larger wire. With a.c. the yield is the mean of the two d.c. yields. It is inferred that the O_3 is formed principally through collisions between electrons and O_2 mols. at energies suitable for mol. dissociation. With the internal electrode negative, collisions occur at dissociation energies principally outside the ionising sheath but well inside the sheath where electrons excite the first crit. potential in O_2 and attach themselves to O_2 mols. When the electrode is positive, collisions at dissociation energies occur in a thin sheath adjacent to the electrode, and dissociations due to ultra-violet radiation of high energy also occur. J. W. S.

Mechanism of photographic development. III. Developing and non-developing reducing agents. T. H. James (*J. Amer. Chem. Soc.*, 1940, 62, 3411–3415; cf. A., 1940, I, 170).—The rate of formation of Ag in solutions of Ag salt complexes in the presence of Na_2SO_3 , Na_2SnO_3 , desylamine, and furoin has been studied. In Ag_2SO_4 complexes the rate is markedly increased by the addition of colloidal Ag or CuSO_4 and depends on $[\text{Ag}^+]$. Na_2SnO_3 reduces the $\text{Ag}_2\text{S}_2\text{O}_8$ complex without Ag catalysis whilst with AgI complex definite Ag catalysis is observed. Desylamine and furoin reduce Ag without Ag catalysis and at rates \approx their O_2 oxidation rates. W. R. A.

Photolysis of the aliphatic aldehydes. VIII. Acetaldehyde. F. E. Blacet and W. J. Blaedel (*J. Amer. Chem. Soc.*, 1940, 62, 3374–3377; cf. A., 1938, I, 366).—Redetermination of

the $\text{H}_2:\text{CO}$ ratio at 2654 Å. shows a max. at $\sim 30^\circ$ and it is found that on cooling to $< 0^\circ$ the ratio slowly diminishes with decreasing temp. In the condensable products Ac_2 , glyoxal, and CH_2O have been detected, particularly at lower temp., but COMe_2 and methylglyoxal were not found. The primary dissociation appears to be $\text{MeCHO} + h\nu \rightarrow \text{Me} + \text{HCO}$ (i) followed by $\text{MeCHO} + \text{HCO} \rightarrow \text{H}_2 + \text{CO} + \text{MeCO}$ (ii), $\text{MeCHO} + \text{Me} \rightarrow \text{CH}_4 + \text{MeCO}$ (iii), $\text{MeCO} + \text{MeCHO} \rightarrow \text{Me} + \text{CO} + \text{MeCHO}$ (iv), $2\text{MeCO} \rightarrow (\text{MeCO})_2$ (v), $2\text{HCO} \rightarrow (\text{HCO})_2$ (vi), and $2\text{HCO} \rightarrow \text{CH}_2\text{O} + \text{CO}$ (vii). W. R. A.

Chain photolysis of acetaldehyde in intermittent light. W. L. Haden, jun., E. P. H. Meibohm, and O. K. Rice (*J. Chem. Physics*, 1940, 8, 998).—The decomp. of MeCHO in intermittent light, produced by the use of a rotating sector, has been investigated. Since the rate of decomp. is dependent on (light intensity) $^{1/2}$, the quantum yield (η) with a rapidly moving sector is > with a slowly moving sector. At 200° and 20 cm. pressure the change in η occurs with ~ 2 rotations per sec., indicating that the reaction chain lasts ~ 0.5 sec. Comparison with the data of Grahame and Rollefson (A., 1940, I, 170) indicates that under these conditions η is ~ 48 , and the chain length ~ 24 if two chains are initiated per quantum. Assuming the effective collision radius to be 3.5 Å, the Me radical makes $\sim 7 \times 10^8$ collisions in 0.5 sec., so one collision in $\sim 3 \times 10^{-7}$ results in reaction, this corresponding with a max. activation energy of 16 kg.-cal. per g.-mol. J. W. S.

Free radicals in the photolysis of propaldehyde. L. May, H. A. Taylor, and M. Burton (*J. Amer. Chem. Soc.*, 1941, 63, 249–254).—Free alkyl radicals are produced to approx. the same extent in the photolysis of EtCHO and of COMe_2 ; they have half-life vals. of 3.8 and 4.6×10^{-3} sec., respectively. Free formyl radicals are stable up to 100° and free H atoms comprise <2% of mirror-active particles produced by photolysis. Photolysis of EtCHO appears to be a chain reaction in which there are competing free radical decomp. W. R. A.

Photolysis of organic nitrogen compounds. III. Methyl isocyanate. D. A. Bamford and C. H. Bamford (*J.C.S.*, 1941, 30–34).—The absorption spectrum of MeNCO at 15° and 140° appears completely continuous at <2350 and <2400 Å., respectively. Analysis of the products of the Hg-sensitised photochemical decomp. of MeNCO in light of 2100–2400 Å. at 20–347° confirms that the initial decomp. involves dissociation in two distinct ways, yielding Me and NCO, and NMe and CO radicals, respectively, the former being the more important the higher is the temp. The quantum yield of CO from MeNCO at 307° is ~ 1 . High yields of H_2 and CO in the Hg-sensitised reaction at high temp., and particularly in the direct photolysis with a hot arc, indicate the formation of CH_3O , probably by interaction of NMe and MeNCO. In presence of NO the NCO and NMe radicals both react with this gas, forming N_2 and CO_2 , and Me radicals and N_2O , respectively. The fact that the decomp. of NCO into N_2 and CO is more important in the sensitised reaction than in the direct photolysis is attributed to the formation of HgNCO, as a radical, in the former reaction. This is assumed to be capable of decomp. in the same way as NCO but not to be so easily hydrogenated. J. W. S.

Photolysis of mercaptans. N. P. Skerrett and N. W. Thompson (*Trans. Faraday Soc.*, 1941, 37, 81–82).—MeSH vapour is decomposed when irradiated by Hg 2537 Å., giving chiefly Me_2S_2 and H_2 with small amounts of CH_4 and S, with a quantum yield ~ 1.7 . A mechanism involving the primary formation of MeS and H is proposed. These results agree with those obtained previously (cf. A., 1938, I, 633) in suggesting that the lower alkyl mercaptans are photolysed predominantly by the primary process $\text{RSH} \rightarrow \text{RS} + \text{H}$ and not $\text{RSH} \rightarrow \text{RH} + \text{S}$. F. L. U.

Photochemical decomposition of malonic acid. I. D. S. Rao (*J. Univ. Bombay*, 1940, 9, Part 3, 94–103).—From analyses of the products of the photochemical decomp. of aq. $\text{CH}_2(\text{CO}_2\text{H})_2$, irradiated by means of a SiO $_2$ lamp, it is inferred that the primary decomp. takes place in three ways, with formation of (a) $\text{H}_2\text{C}_2\text{O}_4$ and C_2H_4 , (b) $\text{H}_2\text{C}_2\text{O}_4$ and $(\text{CH}_2\text{CO}_2\text{H})_2$, and (c) CO_2 and AcOH . Secondary decomp. of $\text{H}_2\text{C}_2\text{O}_4$ yields CO_2 and HCO_2H , the latter in turn giving rise to CO and H_2O . J. W. S.

Effect of application of sonic energy to hydrolysis of potassium persulphate. W. C. Schumb and E. S. Rittner (*J. Amer. Chem. Soc.*, 1940, 62, 3416–3420).—The rates of hydrolysis

of $K_2S_2O_8$ at 60°, 70°, and 80°, and at 25°, 60°, and 70° with the application of sonic energy, have been investigated by the use of an improved apparatus. In the ordinary hydrolysis the unimol. reaction coeff. k decreased with increasing concn. except in the course of a single experiment at 60° over a period of 2 days when k increased with time. On the application of sonic energy and elimination of partly thermal effects and any catalytic effect due to metallic Ni, k increased with increased time of vibration, increasing vol. (concn. remaining const.), and with increasing $[K_2S_2O_8]$. The effect was too small to measure at 25°, but measurements at 60° and 70° indicate that the effect was slightly greater at 60° than at 70°.

W. R. A.

IX.—METHODS OF PREPARATION.

Acid-base reactions, their analogy to oxidation-reduction reactions in solution. T. H. Hazlehurst (*J. Chem. Educ.*, 1940, 17, 466–468).—A discussion in which acid-base reactions are shown to be closely analogous to oxidation-reduction reactions; they are not double decomp. reactions. Chemical reactions in general are classified. L. S. T.

Preparation of pure water. A. I. Baibaev (*J. Appl. Chem. Russ.*, 1940, 13, 499–505).—Conductivity H_2O is obtained in a single operation, using simple apparatus, by distillation of distilled H_2O from a non-volatile acid, with condensation at $<60^\circ$. R. T.

Comparison of methods of preparation of heavy water. A. I. Brodski (*J. Appl. Chem. Russ.*, 1940, 13, 670–676).—A crit. survey of methods, including fractional distillation, continuous electrolysis in cascade, and thermodiffusion of H_2O vapour or H_2 , leads to the conclusion that the ordinary method is at present the only practicable one, although in theory it is inferior to the others. R. T.

Technology of preparation of heavy water. V. A. Alexandrovitch and M. K. Scheludko (*J. Appl. Chem. Russ.*, 1940, 13, 483–498).—Electrolytic apparatus and methods of prep. of D_2O are described. R. T.

Oxygen exchange between anions and water. N. F. Hall and O. R. Alexander (*J. Amer. Chem. Soc.*, 1940, 62, 3455–3462).— H_2O containing excess of ^{18}O and having an excess ρ of 21.7 γ d was caused to exchange O with dissolved inorg. O compounds at 95–100° and under different conditions of time of contact, and p_H . The extent of exchange has been determined by measurement of ρ using the magnetically-controlled swimmer and it has been found to yield the most satisfactory data when used near the temp. of max. ρ . Complete exchange ($>95\%$) occurs with (min. time of contact in hr. in parenthesis) CrO_3 (5), $Na_2Cr_2O_7$ (5), Na_2CrO_4 (2), K_2MoO_4 (25), Na_2WO_4 (6), $NaBO_2$ (4), K_2CO_3 (22), KH_2AsO_4 (14), $KAsO_4$ (9), $NaMnO_4$ (?), $NaIO_3$ (48), Na_2SeO_4 (5), K_2SO_3 (8), $Na_2S_2O_3$ (5). KNO_3 , $NaNO_3$, $Mg(ClO_4)_2$, $Ba(ClO_4)_2$, $NaClO_3$, Na_2SeO_4 , and Na_2SO_4 show practically no exchange, whilst $NaBrO_3$, and possibly $NaIO_3$ and $NaMnO_4$, show partial exchange. Addition of NaOH does not appreciably affect the exchange with Na_2CrO_4 , K_2MoO_4 , Na_2WO_4 , $NaNO_3$, KH_2AsO_4 , $KAsO_4$, $NaMnO_4$, $Ba(ClO_4)_2$, $NaClO_3$, $NaBrO_3$, $NaIO_3$, Na_2SeO_4 , Na_2SO_4 , and $Na_2S_2O_3$, but retards the exchange with K_2SO_3 and $Na_2S_2O_3$. Addition of acid accelerates for Na_2SO_4 and Na_2SeO_4 but appears to have little influence on $NaNO_3$ and $Mg(ClO_4)_2$. W. R. A.

Instability of silver perchlorate. S. R. Brinkley, jun. (*J. Amer. Chem. Soc.*, 1940, 62, 3524).— $AgClO_4$, recryst. from C_6H_6 and kept for 15 hr. in a desiccator at 10 mm., appeared to be superficially dry but caked. A violent explosion sometimes occurred when the cakes were broken by gentle pressure in a mortar. This detonation involves the $AgClO_4$ - C_6H_6 additive compound and similar detonations are known to occur with the $AgClO_4$ -EtOH additive compound. The instability is unpredictable. W. R. A.

Bleaching powder.—See B., 1941, I, 99.

Metallo borohydrides. I. Aluminium borohydride. H. I. Schlesinger, R. T. Sanderson, and A. B. Burg. **II. Beryllium borohydride.** A. B. Burg and H. I. Schlesinger. **III. Lithium borohydride.** H. I. Schlesinger and H. C. Brown (*J. Amer. Chem. Soc.*, 1940, 62, 3421–3425; 3425–3429; 3429–3435).—I. Al_2Me_6 reacts with B_2H_6 thus: $Al_2Me_6 + 4B_2H_6 \rightarrow 2BMe_3 + 2AlB_2H_{12}$. A similar reaction takes place between $AlMe_3$, Et_2O and B_2H_6 with formation of BMe_3

and other (unidentified) products. Before AlB_2H_{12} can be successfully prepared there must be excess of B_2H_6 ; otherwise a complex mixture of compounds of unknown composition is formed. AlB_2H_{12} appears to be a normal liquid, m.p. $-64.5 \pm 0.5^\circ$, v.p., $\log p = 7.808 - 1565/T$. It reacts readily with air, inflaming spontaneously with a very brilliant bluish-white flash. It hydrolyses rapidly thus: $AlB_2H_{12} + 12H_2O \rightarrow 12H_2 + 3H_3BO_3 + Al(OH)_3$, and with HCl even at -80° , reacts readily thus: $2AlB_2H_{12} + 6HCl \rightarrow 6H_2 + 3B_2H_6 + Al_2Cl_6$. On heating H_2 is evolved and ultimately dark metallic crystals, possibly of AlB_2 , are formed together with an amorphous black solid which reacts with H_2O to give H_2 . Equimol. quantities of Me_3O and AlB_2H_{12} yield readily, even at -80° , a slightly volatile compound, $(AlB_2H_{12}, OMe)_n$. With NMe_3 at -80° a white cryst. compound, AlB_2H_{12}, NMe_3 , m.p. 79° , is formed; at $\sim 100^\circ$ it yields borine trimethylamine and an oily liquid, possibly AlB_2H_9 . When AlB_2H_{12} is treated with excess of NMe_3 at -80° (1 : ~ 6) a compound (approx. 3 : 1), unstable to heat, is formed. Equimol. quantities of AlB_2H_{12} and NH_3 at -80° give a mixture of an amorphous white solid and crystals which in 0.5 hr. at 0° are completely converted into the amorphous solid. Attempts to prepare AlH_3X ($X = NMe_3$ or NH_3) were unsuccessful.

II. Interaction of $BeMe_2$ with excess of B_2H_6 yields Be borohydride, BeB_2H_8 , which reacts readily with air and H_2O , and with HCl at -80° gives H_2 , B_2H_6 , and chlorodiborane. The v.p. of BeB_2H_8 is given by $\log p$ (mm.) $= 11.772 - 3240/T$; the m.p. could not be ascertained because of slight decomp. at 123° . NMe_3 and BeB_2H_8 (~ 6 : 1) at -80° react to give a mixture of compounds, including BeB_2H_8, NMe_3 , which is also formed from equimol. quantities of the reactants and reacts explosively with air or H_2O . V.p. of BeB_2H_8, NMe_3 from 65° to 140° are represented by $\log p$ (mm.) $= 8.353 - 2909/T$. The NMe_3 is tightly held in the additive compound since this compound does not yield borine trimethylamine with B_2H_6 even at 70° . BeB_2H_8, NMe_3 reacts with NMe_3 to give $BeBH_3, NMe_3$ (I) and BH_3, NMe_3 . (I) tends to lose NMe_3 and produces an oily material which with B_2H_6 gives BeB_2H_8 .

III. $LiEt$ and B_2H_6 react at room temp. with formation of Et derivatives of B_2H_6 and a white, stable, non-volatile solid, m.p. $275-280^\circ$ (decomp.), which has been proved to be $LiBH_4$ by comparing the composition of the volatile products with that of the starting materials and by treating $LiBH_4$ with $MeOH$, when the following reactions occur: $LiBH_4 + 4MeOH \rightarrow LiB(OMe)_4 + 4H_2$; $LiB(OMe)_4 \rightarrow LiOMe + B(OMe)_3$. $LiBH_4$ reacts readily with HCl even at -80° giving $LiCl$, H_2 , and B_2H_6 but does not react with dry air. It also differs from AlB_2H_{12} and BeB_2H_8 in its salt-like character and in the fact that NMe_3 has no action on it. AlB_2H_{12} reacts with $LiEt$ thus: $3LiEt + Al(BH_4)_3 \rightarrow 3LiBH_4 + AlEt_3$, indicating that the basic structures of Al , Be , and Li borohydrides are closely related and that the differences in chemical and physical properties arise from differences in the degree of polarisation or distortion of the BH_4 groups. BMe_3 , either in presence or in absence of a solvent, is absorbed by $LiEt$ at room temp. yielding a white cryst. solid with empirical composition $LiEt, BMe_3$, which appears to be a quaternary B derivative. This compound is sol. in C_6H_6 , is stable to dry air, and dissolves in H_2O with slow evolution of gas. By comparing the reactions of the borohydrides described in these papers the tendency to react as BH_4 derivatives is for $Al(BH_4)_3 > Be(BH_4)_2 > LiBH_4$ and the tendency to react as BH_3 derivatives diminishes in the same sequence. Polar character increases: $B_2H_6 < Al(BH_4)_3 < Be(BH_4)_2 < LiBH_4$, and chemical stability increases in the same order. Whilst B_2H_6 is essentially an aggregate of 2 BH_3 groups and $LiBH_4$ is a true BH_4 derivative, the Al and Be compounds are equilibrium mixtures, $AlH_3, 3BH_3 \rightleftharpoons Al(BH_4)_3$ and $BeH_2, 2BH_3 \rightleftharpoons Be(BH_4)_2$. W. R. A.

Separation by thermal diffusion of mixtures of gases having the same molecular weight. F. T. Wall and C. E. Holley, jun. (*J. Chem. Physics*, 1940, 8, 949–953).—Using a thermal diffusion column comprising three concentric brass tubes 274 cm. long, with internal and external temp. of 235° and 21° , respectively, the separation of CO_2 - C_2H_6 , CO_2 - N_2O , N_2O - C_2H_6 , CO - C_2H_6 , CO - N_2 , and N_2 - C_2H_6 mixtures has been investigated. Except for CO_2 - N_2O mixtures, for which the separation is \gg the predicted val., the order of magnitude and the directions of the separations are in accord with those deduced theoretically on the assumption that the mols. behave as elastic spheres. J. W. S.

Action of phenolphthalein on insoluble hydroxides. G. Sachs (*J. Amer. Chem. Soc.*, 1940, **62**, 3514—3515).—The hydroxides of Pb, Cd, Co, Ni, Mn^{II}, Zn, and Mg are coloured by phenolphthalein (I), whilst those of Sn^{II}, Sn^{IV} (?), Sb^{III} (?), Bi^V, Al, Fe^{III}, and Cr are not. With those of Cu and Bi coloration is obtained only when the hydroxide is prepared in excess of alkali. Development of colour is due to activated adsorption of (I) on the hydroxide. Those which are coloured are cryst. on formation according to X-ray evidence.

W. R. A.

Further concentration of ³⁴S. D. W. Stewart and K. Cohen (*J. Chem. Physics*, 1940, **8**, 904—907).—The exchange reaction between SO₂ and aq. NaHSO₃, carried out in three countercurrent fractionating columns, has been used to separate 55 g. of Na₂SO₃ containing 25% of ³⁴S. J. W. S.

Sulphuryl iodide. M. R. A. N. Rao (*Proc. Indian Acad. Sci.*, 1940, **12**, A, 354—356).—SO₂Cl₂ in CCl₄ (0.0005M.) reacts with dry KI in the dark to give I and SO₂ even at -10°. When a 0.005M. solution of SO₂Cl₂ in CS₂ is shaken with dry KI in the dark at -70° for 2—3 min. a violet solution is obtained. The intensity of the coloration increased on heating and continued to increase on subsequent cooling. Hence the SO₂I₂ primarily formed decomposes when heated to SO₂ and I which do not recombine. No alteration in coloration was evidenced when the original violet solution was maintained at -70°. SO₂I₂ is therefore probably colourless. Spectrograms of SO₂I₂, and of SO₂ + I₂ formed from SO₂I₂ and artificially mixed, are reproduced.

W. R. A.

Selenium iodide. M. R. A. N. Rao (*Proc. Indian Acad. Sci.*, 1940, **12**, A, 410—415).—When a dil. solution of Se₂Cl₂ in CCl₄ was shaken in the dark at -10° for 2 min. with dry KI the solution turned yellow and on exposure to light immediately became violet and deposited crystals of Se. At 25° the reaction took about 10—15 min. because Se and I were adsorbed on KI and reduced the effective area of the solid. When Se₂I₂, prepared by the above method, is shaken up with an aq. suspension of CdCO₃ two reactions occur: (a) Se₂I₂ → 2Se + I₂; (b) 2Se₂I₂ + 3H₂O → 3Se + H₂SeO₄ + 4HI. 10—15% of the Se₂I₂ hydrolyses whilst the remainder is decomposed according to (a). The decomp. has been followed by absorption spectra measurements. Freshly prepared Se₂I₂ absorbs all λλ < 5900 Å., but as decomp. proceeds the solution becomes more transparent in the violet. The formation of Se₂I₂ from Se and I in CCl₄ is considered improbable.

W. R. A.

Existence of higher hydrates of ferric oxide as transition intermediates. L. A. Welo and O. Baudisch (*Phil. Mag.*, 1941, [vii], **31**, 103—114; cf. A., 1937, I, 474).—The transformation of γ-Fe₂O₃ into α-Fe₂O₃ in contact with H₂O has been followed at a series of temp. between 71.3° and room temp. by following the change in magnetic permeability. The transformation is of zero order at all the temp. used, abrupt changes in rate being found at most temp. It is concluded that the transformation takes place by a no. of alternative routes, all similar to that postulated for 136° in the authors' earlier paper, but involving a variety of higher hydrates of α- and γ-Fe₂O₃, besides α- and γ-FeOOH. The γ-α transformation of Fe₂O₃ in dry tubes may depend on the presence of traces of H₂O.

L. J. J.

Heating curves of iron ochre. V. E. Tartakovskaja and J. G. Chazina (*J. Appl. Chem. Russ.*, 1940, **13**, 866—868).—Two min. are observed in the heating curve, at 349° and 580°, and one max. at 980°. These are due, respectively, to dehydration of Fe hydroxides and of kaolin, and to an exothermic reaction of kaolinite at about 1000°. The fall in oil capacity following calcination of ochre is due to the diminution of active surface as a result of these reactions.

R. T.

Formation and stability of the halogen and cyanogen derivatives of the carbonyls and complex carboxycyanides. II. B. Ormont (*Acta Physicochim. U.R.S.S.*, 1940, **12**, 759—771).—Theoretical. It is shown in terms of the author's theory (*ibid.*, 412) that compounds [Fe(CO)₅]X₂ (X = halogen) must be thermodynamically unstable with respect to [Fe(CO)₄]X₂. Possible structures for Fe(CO)₅X₂ are (a) Fe(CO)₅X₂, i.e., an additive compound, a mol. lattice; (b) [Fe(CO)₅]X⁺X⁻; (c) [Fe(CO)₅]X⁺X⁻, with an ionic lattice. Reasons for the instability of halogen derivatives of Co and Ni carbonyls, and the possibility of the existence of certain types of carbonyl cyanide derivatives, are discussed.

F. J. G.

X.—ANALYSIS.

Quantitative spectrographic analysis. J. T. M. Malpica (*Gen. Elect. Rev.*, 1940, **43**, 288—297, 333—335).—Special techniques and accessories for increasing the accuracy and sensitivity of quant. spectrography are discussed. A method of relative intensities with internal standards, developed to reduce the effect of the characteristics of the photographic plate in the intensity determinations, is shown to be independent of plate sensitivity, exposure, and time of development. However, the spectral response of the plate is not eliminated and the lines under comparison must be close to the λ scale. Accordingly, a method of relative intensity ratios with external standards has been developed to permit the making of intensity determinations completely independent of the photographic process.

R. B. C.

Phenolphthalein and methyl-orange. C. A. Peters and B. C. Redmon (*J. Chem. Educ.*, 1940, **17**, 525—528).—Electronic interpretations of the behaviour of these two indicators are presented.

L. S. T.

Sampling and analysis of feed and boiler waters.—See B., 1941, I, 82.

Silver phosphate in quantitative analysis. C. R. Johnson and L. G. Nunn, jun. (*J. Chem. Educ.*, 1940, **17**, 528—529).—Ag₃PO₄ (prep. described) is easily prepared in a form sufficiently pure to provide a satisfactory primary standard for Volhard determinations.

L. S. T.

Amperometric titrations. VI. Titration of sulphate and other anions with lead and the reverse titrations. I. M. Kolthoff and Y. D. Pan (*J. Amer. Chem. Soc.*, 1940, **62**, 3332—3335; cf. A., 1940, I, 131).—Sulphate has been titrated amperometrically with Pb(NO₃)₂ between 0.01 and 0.001M. in H₂O and H₂O—EtOH (20—30%) at a potential of the dropping Hg electrode of -1.2 v. in presence of indifferent electrolytes. The conditions for accurate titrations are described. Results of amperometric titrations of Pb with sulphate, oxalate, and iodate, and of oxalate and ferrocyanide with Pb are given.

W. R. A.

Titration of ammonia in presence of boric acid in the macro-, semi-micro-, and micro-Kjeldahl procedures, using methyl-red indicator and the colour-matching end-point. E. C. Wagner (*Ind. Eng. Chem. [Anal.]*, 1940, **12**, 771—772; cf. A., 1934, 47).—Details of prep. of the aq. H₃BO₃, and of the colour-matching titration with special reference to the semi-micro-procedure are given. Essential experimental conditions for the macro-, semi-micro-, and micro-Kjeldahl procedures are tabulated.

L. S. T.

Colorimetric determination of nitrite. M. B. Shinn (*Ind. Eng. Chem. [Anal.]*, 1941, **13**, 33—35).—Sulphanilamide (I) and NH₂·[CH₂]₂·NH·C₁₀H₇·2HCl are used in place of sulphanilic acid and α-C₁₀H₇·NH₂ in the determination of NO₂⁻. The colour develops more quickly (2 min.), is more stable (several hr.), and is less sensitive to variations in pH (acid concns. 0.1–1N.). Standard (I) is substituted as a primary standard for the less stable aq. NaNO₂. Details of procedure and test data are given.

L. S. T.

Organic reagents and methods involving their use. Indirect volumetric determination of metals precipitated by organic reagents of the oxime type. N. H. Furman and J. F. Flagg (*Ind. Eng. Chem. [Anal.]*, 1940, **12**, 738—740).—A BrO₃⁻·AsO₄³⁻ method for determining NH₂OH is described, and is applied to the determination of metals in various types of oxime ppts. NH₂OH is oxidised by a measured vol. of standard KBrO₃ in 3–4N-HCl, standard H₂AsO₄ is added, and the excess is determined by titration with KBrO₃ (Mc-orange). The max. amount of NH₂OH permissible in any determination is 20 mg. A general procedure applicable to metal-oxime ppts. formed under the usual conditions and then dissolved in conc. HCl is detailed. Data for the determination of Cu pptd. with salicylaldehyde or α-benzoinoxime, and of Ni pptd. with dimethylglyoxime, are recorded. The method is suitable for semimicro-quantities of Cu⁺⁺.

L. S. T.

Enhancement by flotation of sensitivity of the reactions for phosphate and arsenate. A. M. Belousov and A. G. Belousova (*J. Appl. Chem. Russ.*, 1940, **13**, 594—595).—5 ml. each of N-(NH₄)₂MoO₄ and of 6N-H₂SO₄ are added to 3 ml. of solution at 35–50°, followed by 2–3 ml. of iso-C₈H₁₁·OH, and the solution is shaken, when a yellow pellicle forms at the phase

interface in presence of $\leq 0.1 \mu\text{g. PO}_4^{4-}$ per ml. 2 ml. of conc. HCl are added to 4 ml. of solution, H_2S is passed (2–3 min. at the b.p.), and the cooled solution is shaken at 50° with 1% CHCl_3 in *iso*- $\text{C}_6\text{H}_{11}\text{OH}$, when As_2S_3 collects at the phase interface ($\leq 2 \mu\text{g. AsO}_4^{3-}$ per ml.). R. T.

Determination of silicic acid. H. Gotô (*Sci. Rep. Tôhoku*, 1940, 29, 440–445).— SiO_2 is obtained in an insol. form which can be filtered and weighed by baking silicates with HCl and treating the residue with AcOH . If baking is carried out at temp. ≥ 150 – 155° , Fe and Al remain in solution after this treatment. The prep. of collodionised filter-paper and its use in the determination of Zn by pptn. with H_2S and weighing as ZnSO_4 are described. O. D. S.

Determination of silicic acid in silicates. V. A. Smirnov and E. N. Isakov (*J. Appl. Chem. Russ.*, 1940, 13, 592–593).—A micro-method, differing from the ordinary micro-method in that the ppt. of SiO_2 is collected and washed on the centrifuge instead of on the filter, is described. R. T.

Determination of carbon monoxide in combustion gases by means of iodine pentoxide.—See B., 1941, I, 94.

Photometric determination of potassium with dipicrylamine. E. Amdur (*Ind. Eng. Chem. [Anal.]*, 1940, 12, 731–734).—A combination of Corning glasses No. 556 and 429 as light filters gives the best results in the photometric determination of K by means of dipicrylamine. A modification of the procedure described by Kolthoff and Bendix (A., 1939, I, 215) is given for K alone and in presence of Na. Li dipicrylamine saturated with K dipicrylamine is used as the reagent. Optimum amounts range from 0.3 to 0.8 mg. of K, but the method can be extended to 80 mg. of K. A Cenco-Sheard-Sanford photometer is used for measuring % transmission. L. S. T.

Use of borofluoric acid in micro-analysis. O. G. Scheintzis (*J. Appl. Chem. Russ.*, 1940, 13, 1101–1103).—A drop of 2N-HBF_4 is added to a drop of solution on a slide, when characteristic micro-crystals form in presence of $\leq \text{K}^+ 1.25$, $\text{Rb}^+ 0.65$, $\text{Cs}^+ 2.5$, or $\text{Ba}^{++} 0.06 \mu\text{g.}$ Mg, Li, Ca, Al, Fe, Cr, Ti, U, Mn, Zn, Co, Ni, Hg^{++} , Pb, Bi, Cu, Cd, Sb, Sn, Ag, Be, Zr, Th, Ce, Au, Pd, Pt, AsO_4^{3-} , AsO_3^{3-} , VO_3^{3-} , WO_3^{3-} , and MoO_4^{2-} do not interfere. R. T.

Determination of potassium by silver cobaltinitrite method.—See A., 1941, III, 236.

Use of magnesium salt of hexanitrodiphenylamine in micro-analysis. O. G. Scheintzis (*J. Appl. Chem. Russ.*, 1940, 13, 1098–1100).—A drop of saturated aq. $\text{Mg}[\text{N}(\text{C}_6\text{H}_4(\text{NO}_2)_3)_2]_2$ is added to a drop of test solution on a slide; characteristic micro-crystals form in presence of $\leq \text{Rb}^+$ or $\text{Cs}^+ 0.04$, $\text{Pb}^{++} 0.25$, $\text{Hg}^{++} 0.5$ – 1 , or $\text{Ti}^{++} 0.05 \mu\text{g.}$ R. T.

Morin reaction for beryllium. E. B. Sandell (*Ind. Eng. Chem. [Anal.]*, 1940, 12, 762–764; cf. A., 1933, 269).—In 0.01–0.1N-NaOH under the conditions described, the sensitivity of the test is 0.01 p.p.m. of Be in daylight, and much greater in ultra-violet light. In 1–2 ml. of solution, 0.001 $\mu\text{g.}$ of Be can be detected. The sensitivity decreases with an increase in [NaOH]. Cu^{++} , Ag, Au, and Mn are sufficiently sol. in NaOH to oxidise and destroy the reagent. In ultra-violet light, Li and Ca in alkaline solution give the same fluorescence as does Be, and that given by Zn is visible in daylight, but is \ll that given by Be. It is destroyed by addition of CN^- without effect on the Be fluorescence. The solubility of $\text{Sc}(\text{OH})_3$ in N-NaOH, and possibly that of $\text{Y}(\text{OH})_3$, is sufficient to give a faint fluorescence in daylight. Many other ions (listed) give no reaction. Metals that give hydroxides sol. in NaOH, with the exception of Zn, do not, in general, interfere with the test for Be in daylight. In presence of CN^- , 1 part of Be can be detected in presence of 2×10^4 of Zn. In daylight, 1 part of Be can be detected in presence of 10^5 of Al, and in ultra-violet light, in presence of 2×10^6 of Al. With metals giving hydroxides insol. in NaOH, Be can usually be detected if an excess of alkali is used, but sensitivity is reduced. Small amounts only of Ca can be prevented from interfering with the test for Be by adding $\text{Na}_2\text{P}_2\text{O}_7$. Alkali fluorides, phosphates, borates, and silicates do not interfere with the Be reaction. L. S. T.

Titan-yellow qualitative test for magnesium. E. B. Otto and C. E. Otto (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 65–66).—An improved spot plate procedure which detects 0.01 mg. of

Mg per ml. is described. The reaction is not suitable for use on paper. A p_{H} of ~ 12.5 is necessary to produce the red colour, and it is better to dilute conc. solutions of Mg^{++} than to use high [NaOH], which give a brownish-orange colour with the reagent, to attain this val. Under different conditions of p_{H} , concn. of ion, and of reagent, the following ions can interfere with the test for Mg^{++} : Ag^+ , Hg^+ , Hg^{++} , Cd^{++} , Ca^{++} , Co^+ , Cu^+ , Pb^+ , Li^+ , Mn^+ , Ni^+ , Cr^{+++} , Fe^{+++} , Fe^{++} , and MnO_4^- , and Al^{+++} , La^{+++} , NH_4^+ , Zn^{++} , Sb^{+++} , Sn^{+++} , and As can prevent the formation of the red colour; tartrate and $\text{Fe}(\text{CN})_6^{4-}$ decrease sensitivity. L. S. T.

Separation method and qualitative test for cadmium ion involving alkaline tartrate complexes. J. P. McReynolds (*J. Chem. Educ.*, 1940, 17, 532).—Of the common cations only Cd, Fe^{+++} , Mg, and the alkaline earth ions are sol. in cold alkaline tartrate solutions and are reprecipitated on heating. To 1 ml. of the group II solution after removal of Pb is added 1 ml. of N-Rochelle salt; the solution is neutralised and made 0.5N. with respect to NaOH. On boiling, $\text{Cd}(\text{OH})_2$ is pptd., and can be confirmed as CdS. Alternatively, the procedure can be applied after separation of Bi^{+++} by means of aq. NH_3 . The test is sensitive to 1 part in 10^5 of Cd^{++} or 1 in 10^4 in presence of much Cu^{++} . L. S. T.

Slow and rapid autoelectro-analysis. J. Guzmán and S. A. Celsi (*Anal. Fis. Quím.*, 1940, 36, 26–32).—The term autoelectro-analysis is proposed for the determination of a metal by deposition on an electrode without the use of an external current. The determination of Cu can be carried out slowly using simple apparatus with Zn-Hg and Cu (or Pt) electrodes in $2\text{N-H}_2\text{SO}_4$; errors are $\geq 0.2\%$. In the rapid determination of Ag the sol. electrode is of Cu and a third electrode of Pt is maintained at const. potential while the electrolyte is kept at 70° . Results by the latter method are less accurate. F. R. G.

Organic reagents for colorimetric analysis. Determination of metals and inorganic radicals. I–IV. N. L. Allport (*Ind. Chem.*, 1940, 16, 311–313, 318, 349–351; 1941, 17, 3–5, 47–48).—Working details of the most successful methods are given for the following: Al^{+++} , Be^{++} , Bi^{+++} , Ca^{++} , Co^{++} , Cu^{++} , Fe^{+++} , Pb^{++} , Mg^{++} , Hg^{++} , Ni^{++} , Sn^{++} , Ti^{+++} , BrO_3^{--} , NO_3^- , NO_2^- , PO_4^{3-} , CS_2 , and Cl_2 . L. S. T.

Determination of manganese by the silver-persulphate method. E. N. Denisov (*J. Appl. Chem. Russ.*, 1940, 13, 596–619).—100 ml. of solution of Mn salt in $2\text{N-H}_2\text{SO}_4$ at 50 – 60° are added to a solution of 5 g. of $\text{K}_2\text{S}_2\text{O}_8$ in 100 ml. of 0.05N- AgNO_3 in $1.5\text{N-H}_2\text{SO}_4$ at 50 – 60° , and this temp. is maintained until the colour changes from black to violet. MnO_4^- is then titrated. R. T.

Determination of cobalt as trioxalatocobaltate. G. H. Cartledge and P. M. Nichols (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 20–21).—The method described is based on the spectrophotometric measurement of the absorption at 605 $\text{m}\mu$. due to $\text{Co}(\text{C}_2\text{O}_4)_3^{3-}$, which is produced by oxidation of Co^{++} by PbO_2 in presence of a weakly acid solution of $\text{K}_2\text{C}_2\text{O}_4$. Cu^{++} and Mn^{++} must be absent, but Ni, Fe, and Cr can be present in considerable amounts. A volumetric method, in which $\text{Co}(\text{C}_2\text{O}_4)_3^{3-}$ is overtitrated with 0.05N- $\text{FeSO}_4(\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$ and the excess of Fe⁺⁺ determined by titration with $\text{K}_2\text{Cr}_2\text{O}_7$ (NH_4Ph_2), is described. L. S. T.

Colour reaction for quadrivalent tin. V. I. Kuznetsov (*J. Appl. Chem. Russ.*, 1940, 13, 769–775).—To 1-aminoanthraquinone in conc. H_2SO_4 is added a solution of 2 g. of NaNO_2 in 10 ml. of conc. H_2SO_4 , and the diazo-salt obtained is coupled with NPhMe_2 in HCl, to yield 1-p-dimethylaminobenzene-azoanthraquinone, m.p. 243° [hydrochloride (I); hexachlorostannate]. Filter-paper is impregnated with a solution of 0.1 g. of (I) and 15 g. of NaCl in 200 ml. of 1% HCl in 30% EtOH; the colour of the paper changes from red to violet when a drop of solution containing $\leq 0.01 \mu\text{g.}$ of Sn^{IV} is placed on it (limiting dilution of Sn^{IV} is 10 p.p.m.). A similar reaction is given by much higher concns. of U, Nb (only in presence of tartrates), Zn, Cd, Hg^{++} , Pt^{IV} , Al, Sb^{III} , Mo, Au, Ir, and Ga; except in the cases of Sn^{IV} , U, and Nb the red colour is restored by placing a drop of dil. HF on the spot. U does not interfere except when $[\text{U}]/[\text{Sn}^{IV}] > 100$. R. T.

Dissolution of coal ash for determination of germanium. IV. I. P. Alimarín and B. N. Ivanov-Emin (*J. Appl. Chem. Russ.*, 1940, 13, 951–955).—Evaporation to dryness of solutions of GeO_2 in HF or $\text{HF-HCl-H}_2\text{SO}_4$ does not involve loss of Ge

as GeF_4 , owing to formation of a stable complex, H_2GeF_6 . However, in presence of alkali halides, considerable loss may occur, so that ash of a high Cl' content cannot be analysed for Ge by this method. 3 g. of ash are heated with 10 ml. each of H_2SO_4 and HClO_4 and 25 ml. of HF, to evolution of SO_2 . 75 ml. of H_2O , 1 g. of H_3BO_3 , 2 ml. of Br, and 200 ml. of conc. HCl are added, the solution is distilled to half its vol. (receiver at 0°), when 150 ml. of HCl are added, and distillation is continued. Br in the distillate is reduced with NH_4OH , the acidity is adjusted to 4–5N. by means of aq. NaOH, 2 g. of H_3BO_3 are added, and the solution is saturated with H_2S . The ppt. is collected after 24 hr., washed, ignited with HNO_3 at $900\text{--}1000^\circ$, and weighed as GeO_2 . R. T.

Rapid determination of antimony, tin, and bismuth. S. Kallmann and F. Pristera (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 8–11).—Details of new short methods for the accurate determination of Sb, Sn, and Bi in metals, alloys, and ores are given. Sb, Sn, and Bi are co-pptd. with MnO_2 formed from Mn^{++} and KMnO_4 in hot, dil. HNO_3 or H_2SO_4 . For Sb and/or Sn, the ppt. of MnO_2 is heated to fuming with H_2SO_4 , KHSO_4 , and $(\text{NH}_4)_2\text{SO}_4$, and to determine the Sb the solution is diluted with aq. SO_2 , boiled down with HCl, diluted, and titrated with KMnO_4 or KBrO_3 (Me-orange). The Sn is reduced by means of Ni and HCl in the solution after titration of the Sb, or in the solution containing the fumed MnO_2 ppt., and finally titrated with standard I. For Bi, the ppt. of MnO_2 is dissolved in dil. HNO_3 and H_2O_2 , and the Bi separated as basic nitrate by means of ZnO . This method eliminates the usual sulphide, carbonate, and basic nitrate separations. The basic nitrate is dissolved in HNO_3 , and the Bi finally pptd. and weighed as BiOCl . Test data and comparative analyses made by standard methods are recorded, and possible interferences are discussed. L. S. T.

Volumetric determination of bismuth. J. G. Carrero (*Anal. Fis. Quim.*, 1940, 36, 33–43).—A modification of the procedure proposed by Stamm and Goehring (A., 1939, I., 102) involves the titration of the CNS' solution either by Lang's method with KCN and KIO_3 , or by KBr and KIO_3 . Greater accuracy is obtained. F. R. G.

XI.—APPARATUS ETC.

High-output electric flask heater. H. A. Krantz and R. W. Huffer (*Ind. Eng. Chem. [Anal.]*, 1940, 12, 752–753).—A 3-l. flask is heated externally by means of three separate Ni-Cr heating units, supplemented by a Bunsen burner. The higher-boiling petroleum fractions ($>343^\circ$) can be distilled by means of this heating unit. Details of construction are given. L. S. T.

Centrifuge cooling unit. H. L. Wunderly and L. S. Smelo (*Ind. Eng. Chem. [Anal.]*, 1940, 12, 754).—A metal cooling unit filled with solid CO_2 is attached to the under side of the centrifuge lid, and maintains a temp. 8° or $9^\circ <$ room temp. (29°) during 10-min. periods. L. S. T.

Introduction of the thyatron into the regulatory system of thermostats. V. G. Sotschevanov (*J. Appl. Chem. Russ.*, 1940, 13, 793–795).—Applications of thyatron relays for thermoregulatory systems are illustrated. R. T.

Adjustable mercury-filled metal thermo-regulator. F. Pagitt (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 60).—The regulator described is rugged, and provides rapid heat transfer, and a simple adjustment for changing temp. over wide ranges. Temp. can be maintained to $\pm 0.001^\circ$ for long periods of time. L. S. T.

Improved Cottrell b.p. apparatus. V. T. Jackson (*J. Chem. Educ.*, 1940, 17, 472).—The difficulty of keeping a const. flow of liquid over the bulb of the Beckmann thermometer is eliminated. L. S. T.

Self-heating hot-bottle. J. St. L. Philpot (*Chem. and Ind.*, 1941, 88).—The device consists of a bag containing ~ 1 lb. of Fe filings mixed with 1% of $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$; the mixture should pass a mesh of ~ 150 per in. When 15 ml. of H_2O are added the temp. rises to $70\text{--}100^\circ$, owing to catalysis of rusting by Cu deposited on the Fe. The bag can be used several times without refilling. A. J. E. W.

Improved radiation pyrometer. T. R. Harrison and W. H. Wannamaker (*Rev. Sci. Instr.*, 1941, 12, 20–32).—The error

involved in the reading of a radiation pyrometer owing to ambient temp. effects is considered, and shown to be considerable. These effects can be compensated by using a Ni resistance shunt in conjunction with a pyrometer having a thermopile with a fairly high conduction factor. Such an instrument is described. It shows ambient temp. errors of $<3^\circ \text{F.}$ in the furnace temp. being measured, for ambient temp. variations of $50\text{--}200^\circ \text{F.}$ The response of the instrument is rapid. A. J. M.

Direct-reading measuring microscope. J. E. Sears and A. Turner (*J. Sci. Instr.*, 1941, 18, 17–19).—Measurements are made to within 0.01 mm. by direct reference to a 305-mm. glass scale and vernier, which can be traversed, together with the photographic film, beneath a low-power microscope in which the film and scale can be viewed together. D. F. R.

Adapting the polarising microscope for use as a polarimeter. A. Marion (*Ind. Eng. Chem. [Anal.]*, 1940, 12, 777).—The adaptation is made by adding to the microscope stage an analyser constructed from two sections of Polaroid cut so that their planes of polarisation include an angle of $\sim 5^\circ$ when semi-circular sections are mounted in place with a slight overlap. The Polaroid analyser is placed at the top of a glass cell of 150 cu.mm. capacity. Performance is illustrated by results obtained with aq. glucose, fructose, maltose, and sucrose. L. S. T.

Time-saving adaptation for photomicrography. J. A. Quense and W. M. Dehn (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 68).—The device renders unnecessary the removal of the camera when the photomicrograph is to be taken without the nicol analyser and with either polarised or unpolarised illumination. L. S. T.

Accurate measurement of X-ray diffraction films. H. P. Klug (*Ind. Eng. Chem. [Anal.]*, 1940, 12, 753–754).—The measuring device is described and illustrated. L. S. T.

Colorimetric analysis of a two-component colour system. H. W. Knudson, V. M. Meloche, and C. Juday (*Ind. Eng. Chem. [Anal.]*, 1940, 12, 715–718).—It is shown experimentally and theoretically how photo-electric filter photometers can be used to resolve the intensity of one colour in presence of a second. Typical experimental results for synthetic mixtures of Fe^{+++} and Al^{+++} and hæmatoxylin are recorded. A method for determining small amounts of Al in natural waters containing only small amounts of Fe is given. L. S. T.

Camera for photographic demonstration. D. H. Gurinsky (*J. Chem. Educ.*, 1940, 17, 432).—A camera in which exposure, development, and fixing can be performed without removing the film is described for demonstrating the photographic process. L. S. T.

Collimated light beams in spectrophotometry. G. O. Langstroth, W. W. Brown, and K. B. Newbound (*Canad. J. Res.*, 1940, 18, A, 186–192).—It has been shown experimentally, in agreement with a theoretical prediction, that a considerable variation of the distance between the linear light source (slit) and the collimating lens is permissible. F. J. G.

Reflecting mirror optical system for the ultracentrifuge. W. G. France and E. R. Lang (*Rev. Sci. Instr.*, 1941, 12, 32–34).—An aluminised reflecting mirror optical system for use in place of the customary long-focus lens with air-driven ultracentrifuges is described. Typical sedimentation pictures taken with the apparatus are given. A. J. M.

Silica gauge for measuring thickness by means of interference colours. K. B. Blodgett (*Rev. Sci. Instr.*, 1941, 12, 10–14).—The construction of a gauge for measuring the thickness of unimol. films by interference of light is described. A SiO_2 film of the correct thickness is obtained on lead glass by treating the glass with HNO_3 . A unimol. layer of the substance to be examined is deposited on the SiO_2 film, and its thickness is determined by observing the change in intensity of reflected light owing to the increased thickness. Equations are given from which the thickness may be calc. A. J. M.

Simple method for refractive index determination. S. M. Cox (*J. Sci. Instr.*, 1941, 18, 20–21).—Measurements are made with $\sim 0.5\%$ accuracy on glass rods, which may be prepared by heating in the flame, without grinding or polishing. D. F. R.

Residual photometric errors in the commercial recording spectrophotometer.—See B., 1941, I, 83.

Apparatus for the study of rapid chemical reactions. D. Dubois (*J. Biol. Chem.*, 1941, 137, 123—137).—A modification of the Thiel and Logemann apparatus (cf. A., 1936, 433) is described. The observation tube (made of transparent plastic) is moved vertically through the light beam, and the changes in light absorption occurring during the reaction are recorded automatically as a curve on a time scale. The average half reduction time of oxyhemoglobin is found to be 0.028 sec. (temp. 20—27°, p_{H} 8.4—9.5), compared with Millikan's val. of 0.038 sec. at 22° and p_{H} 8.6 (A., 1936, 1224). E. M. W.

Apparatus for plating hydrogen electrodes. V. A. Lamb (*J. Chem. Educ.*, 1940, 17, 539).—Apparatus is described. Pd-black is preferred to Pt-black on account of easier removal of old deposits and less poisoning of the electrodes. L. S. T.

Silver chloride electrode in acid-base titrations. J. E. Vance (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 68).—Advantages over the HgCl electrode are that the possibility of plating-out Hg on the H electrode is eliminated, the liquid junction is avoided, and the experimental arrangement is simplified since the Ag-AgCl electrode is immersed directly in the acid being titrated. In titrating acids other than HCl, NaCl is added to provide Cl⁻. For HBr or HI the corresponding halide electrode is used. The quinhydrone can replace the H electrode, and during the titration p_{H} must then be kept ≥ 8.5 . L. S. T.

Use of a condenser to reduce galvanometer oscillations in polarographic measurements, with particular application to compensation method of measuring small diffusion currents. J. J. Lingane and H. Kerlinger (*Ind. Eng. Chem. [Anal.]*, 1940, 12, 750—752).—The galvanometer oscillations are damped, without affecting the diffusion current, by connecting an electrolytic condenser of high capacitance across the galvanometer shunts. Application of this principle extends greatly the practical applicability of the compensation method of measuring small diffusion currents. An improved compensation circuit is described. L. S. T.

Electronic relay. C. E. Rudy, jun., and P. Fugassi (*Ind. Eng. Chem. [Anal.]*, 1940, 12, 757).—A circuit utilising a cold-cathode, starter anode, gas-filled tube is described and illustrated. The many advantages of such a tube over a hot-cathode, high-vac. tube are described. L. S. T.

Regulated filament emission for cyclotrons. E. Pollard (*Rev. Sci. Instr.*, 1941, 12, 37).—Unsteadiness in cyclotron beams may be due to variation in filament emission. A method for keeping the emission current steady, thus avoiding variations in the cyclotron beam of $>2\%$ during a proton count, is described. The use of the regulator also results in considerably longer life of the filaments. A. J. M.

Filament-bearing balance. J. de Ment (*J. Chem. Educ.*, 1940, 17, 437).—Sensitive balances carrying loads of 20—40 g. can be constructed from a wooden beam suspended from a human hair or a steel wire. An ordinary knife-edge bearing balance can be converted into a semimicro-balance by the use of the filament-bearing principle. L. S. T.

Determination of the centre of gravity of the beam of a chemical balance. H. V. Moyer (*J. Chem. Educ.*, 1940, 17, 540).—A method is described. L. S. T.

Gravimetric analysis by means of the thermo-balance. M. Kobayashi (*Sci. Rep. Tôhoku*, 1940, 29, 391—411).—A bibliography of papers (1936—1940) giving data for the variation with temp. of heating in the wts. of compounds commonly used for the gravimetric determination of 62 chemical elements. O. D. S.

Micro-burettes and -pipettes based on the principle of capillarity. M. P. Poljakov (*J. Appl. Chem. Russ.*, 1940, 13, 638—640).—Capillary micro-burettes and -pipettes are described. R. T.

Gasometer for micro-Dumas determinations. J. G. Sandza and J. F. Alicino (*Ind. Eng. Chem. [Anal.]*, 1940, 12, 776—777).—The gasometer described is constructed from two test-tubes and delivers a measured vol. of CO₂ confined over H₂O in a system closed to the atm. The abs. blank is 0.014 \pm 0.001 ml. L. S. T.

Micro-apparatus for fractional recrystallisation. L. C. Craig (*Ind. Eng. Chem. [Anal.]*, 1940, 12, 773—774).—A filter stick suitable for filtration of the solution just before the final crystallisation, and two centrifuging vessels for crystallisation of small quantities of material from small vols. of conc. solutions, are described and illustrated. L. S. T.

Distinguishing individual quantitative filter-papers. C. E. Otto (*J. Chem. Educ.*, 1940, 17, 519).—Aq. solutions of different coloured dyes are streaked along the edges of a packet before it is broken. Suitable dyes are Water Blue, Nigrosine CPP, Erie Fast Scarlet 4BAP, and Auramine OP. L. S. T.

Laboratory-size leaf-type pressure filter. T. F. Clark, N. Porges, and S. I. Aronovsky (*Ind. Eng. Chem. [Anal.]*, 1940, 12, 755—757).—The filter described has an effective filtering surface of 54 sq. in., and a calc. wet-cake capacity of 0.69 l. Hydraulic pressures up to 30 lb. per sq. in. have been used. The filter leaves are adaptable to either top or bottom drainage. L. S. T.

Supersonic oscillator. B. H. Porter (*Ind. Eng. Chem. [Anal.]*, 1940, 12, 748—749).—The laboratory model described consists essentially of a high-voltage rectifier and an oscillator that motivates a quartz crystal in a dielectric fluid. L. S. T.

Acetone-ether mixtures for drying glassware. A. E. Markham (*Ind. Eng. Chem. [Anal.]*, 1940, 12, 748).—A mixture of COMe₂ (1 vol.) and Et₂O (1 vol.) is more efficient than pure COMe₂, and has a better solvent power for greases, especially the usual stopcock preps. L. S. T.

Determination of chemical stability of glass.—See B., 1941, I, 101.

Grinding and scratching crystalline surfaces. R. S. Rivlin (*Nature*, 1940, 146, 806—807).—De Gramont's method of studying a surface broken into many small facets of various orientations can be applied to the ground surfaces of transparent materials. A ground, (0001) plane of quartz gives a refraction pattern which can be used to determine the a axes. Refraction patterns have also been obtained for ground surfaces of calcite, selenite, rock-salt, etc. Any marked cleavages possessed by a crystal are apparent in the refraction patterns of ground or scratched surfaces. The patterns also indicate zones of easy fracture. L. S. T.

[Laboratory] hood. I. Lin (*J. Chem. Educ.*, 1940, 17, 447).—A glass funnel is inverted over the vessel in which evaporation is taking place, and is connected through a wash bottle to a water pump. L. S. T.

Automatic mercury valve. H. B. McGlade (*Science*, 1940, 92, 464).—The arrangement described prevents the forcing or accidental spilling of Hg from an open tube without interfering with the flow or oscillation of the Hg. L. S. T.

Vapour density apparatus. J. M. Hendel and O. Ochsenreiter (*J. Chem. Educ.*, 1940, 17, 533—535).—An improved form of the Victor Meyer apparatus, giving a precision of 2% in mol. wt. determinations, is described. L. S. T.

High rotational speeds in vacuum. C. S. Smith (*Rev. Sci. Instr.*, 1941, 12, 15—20).—Rotors freely suspended in a high vac. were rotated at high speed by electrostatic and electromagnetic forces. The highest speed attained was 3200 r.p.s. A. J. M.

High-pressure valve. M. J. Moore (*J. Sci. Instr.*, 1941, 18, 23).—The valve consists of a hard rubber tapered plug in a metal seating. Leakage past the spindle to which the plug is attached is prevented by a circular rubber diaphragm fixed between the spindle and valve seating. The valve has been used satisfactorily up to 50 atm. in a Wilson expansion chamber. D. F. R.

Determination of average mol. wts. or particle sizes for polydispersed systems. E. O. Kraemer (*J. Franklin Inst.*, 1941, 231, 1—21).—Mathematical. A consideration of the interrelation of several types of average vals. of significance in determinations by indirect methods, and of conditions under which different averages may be calc. from each other. The methods examined are Staudinger's viscosity rule for average mol. wt., average axial ratio and particle size from viscosity of ellipsoidal particles, and average particle size from light absorption. N. M. B.

Effect of gravitational field on the thermal diffusion separation method. M. Farber and W. F. Libby (*J. Chem. Physics*,

1940, 8, 965—969).—The effect of a gravitational field on the thermal diffusion method of gas separation has been investigated by the use of a hollow spinning disc, with one hot surface. For $\text{He}-\text{CO}_2$ mixtures both the equilibrium separation and the rates of separation increase with increasing centrifugal force up to a max. val., after which both fall rapidly. The results indicate that the standard thermal diffusion column would be improved by placing it in a gravitational field of ~ 10 times the normal val. J. W. S.

Theory of separation of mixtures by the thermo-diffusion method. A. I. Brodski (*J. Appl. Chem. Russ.*, 1940, 13, 663—669).—The application of the Clusius-Dickel thermo-diffusion method (A., 1938, I, 539) to separation of gaseous mixtures is discussed, and its applications are illustrated for sp. cases.

Removal of stopcock grease from burette tips. C. B. White and R. C. McGlenn (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 61).— CCl_4 is employed. L. S. T.

Vacuum still for purification of a single substance or recovery of a single fraction. F. C. Holmes (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 61).—Two receiving vessels are connected to the lower end of the condenser by means of a T-shaped tube, and the distillate is directed into one or other of the receivers by tilting the whole apparatus. The apparatus is suitable for purification of a few ml. of oleic acid, in which a rapid change of receivers is essential. L. S. T.

Convenient method for conducting the Kjeldahl digestion. B. O. Heston and S. R. Wood (*J. Chem. Educ.*, 1940, 17, 475).—A Gooch crucible is fitted tightly into the mouth of the digestion flask by means of Pb or Sn foil. The crucible is filled two thirds full with loosely-placed asbestos moistened with conc. H_2SO_4 . The acid fumes from the digestion are then absorbed completely. L. S. T.

Nomograph for correcting barometer readings for temperature. S. M. Troxel (*J. Chem. Educ.*, 1940, 17, 431).

Simple test for straight-line relationships. D. E. Babcock (*J. Chem. Educ.*, 1940, 17, 440).—The method illustrated for determining whether a linear relationship exists between physico-chemical data is based on the condition that the area of a triangle formed by three points in a straight line is zero. L. S. T.

XII.—LECTURE EXPERIMENTS AND HISTORICAL.

Lecture demonstrations in general chemistry. S. B. Arenson (*J. Chem. Educ.*, 1940, 17, 434—436, 469—472, 513—515).—Selected demonstrations of various types are described. L. S. T.

XIII.—GEOCHEMISTRY.

Measurement of the excess weight of air oxygen by exchange with inorganic salts. O. R. Alexander and N. F. Hall (*J. Amer. Chem. Soc.*, 1940, 62, 3462—3464).—The density difference due to O alone has been determined for two samples of H_2O (Madison tap and Lake Michigan). Lake Mendota H_2O , purified by refluxing with KMnO_4 and alkali for 12 hr. and then distilled, was used as standard. Purified air was caused to react with excess of H_2 to give another reference H_2O . The O exchange between H_2O and $\text{K}_2\text{Cr}_2\text{O}_7$ was measured by changes in ρ . If Lake Mendota H_2O is normal in O isotopic composition the atm. O_2 has an excess ρ of 7.1 ± 0.2 γ d. Madison tap H_2O is 0.88 γ d lighter than Lake Mendota H_2O and Lake Michigan is 0.15 γ d denser. W. R. A.

Radium content of mineral springs in Japan. T. Nakai (*Bull. Chem. Soc. Japan*, 1940, 15, Suppl., 333—426).—477 determinations by the Rn emanation method of the Ra content of thermal springs and brines from oil fields from different parts of Japan are tabulated. The geographical distribution of Ra is shown, and a comparison of mineral waters in other countries is made; those of Japan are comparatively poor in Ra. The highest concns. vary from 1 to 11×10^{-11} g. per l. The mineral springs of Masutomi, Yamanashi Prefecture, have the highest Ra content of the Japanese cold springs. The hot springs of Misasa, Tottori Prefecture, are the most radioactive in Japan and rank second to Ischia in Italy. Data for these and other springs are recorded, and relationships between Ra and Rn contents, and

orifice temp., and p_{H} are discussed. Chemical classifications of mineral springs and their Ra contents are also discussed. Data for the extraction of Ra from mineral waters by means of various ptns. are given. The best results are obtained by using Ba, Ca, and Sr sulphates and carbonates as carriers. The % amount of Ba pptd. with or adsorbed by MnO_2 or $\text{MnO}_2 + \text{Fe}_2\text{O}_3 \cdot n\text{H}_2\text{O}$ is also large. L. S. T.

Ecological aspects of the intertidal area of the Estuary of the Aberdeenshire Dee. A. Milne (*Trans. Roy. Soc. Edin.*, 1940, 60, 107—139).—Data concerning temp., $[\text{H}^+]$, and salinity are recorded, and the intertidal fauna and their different distributions are described. The estuary has only $\frac{1}{3}$ to $\frac{1}{5}$ of the species (macrofauna) common to long estuaries. This is due apparently to the high fluctuation in salinity and the absence of mudflats. Salinity is responsible chiefly for distribution in this estuary. *Mytilus* is sensitive to salinity even when apparently tightly closed, and the salinity of the retained H_2O of both *Mytilus* and *Patella*, when uncovered at low tide, is never $< a$ min. val. L. S. T.

Geology and ground-water resources of the "Equus Beds" area in south central Kansas. S. W. Lohman and J. C. Frye (*Econ. Geol.*, 1940, 35, 839—866).—The H_2O -bearing formations, the results of test drillings, the shape of the H_2O table and movement of H_2O , and H_2O -level fluctuations are described and illustrated. L. S. T.

Radioactivity of ocean sediments. III. Radioactive relations in ocean water and bottom sediment. C. S. Piggot and W. D. Urry (*Amer. J. Sci.*, 1941, 239, 81—91; cf. A., 1940, I, 44).—The highest concns. of Ra ($3-22 \times 10^{-12}$ g. per g.) occur in a so-called red clay, a fine-grained material found underlying very deep H_2O . The U content of bottom sediments is insufficient to maintain the high [Ra] found in and near the surface of these sediments. The high Ra contents in the surface material often appear to be due to deposition of an excess of Io. They are superficial and of no great geophysical significance, and at greater depths in the sediments the Ra content reaches a val. in equilibrium with the U. This Ra content is comparable with that of sedimentary rocks ($0.05-0.5 \times 10^{-12}$ g. per g.). Various mechanisms for the mode of distribution of the radio-elements between the ocean and its sediments are discussed. L. S. T.

Synthesis and X-ray analysis of gehlenite and anorthite. K. Akiyama (*J. Soc. Chem. Ind. Japan*, 1940, 43, 341b).—Gehlenite and anorthite have been synthesised from CaO , Al_2O_3 , and SiO_2 , at 1450° , and their X-ray diffraction patterns recorded. Each is a single compound. F. J. G.

Zoning in spherulites. A. D. Howard (*Amer. Min.*, 1940, 25, 614—618).—The origin of zoning in natural and artificial spherulites is discussed. L. S. T.

Crystallography of dolerophanite. W. E. Richmond and C. W. Wolfe (*Amer. Min.*, 1940, 25, 606—610).—Rotation and Weissenberg photographs give a_0 9.39, b_0 6.30, c_0 7.62 Å., β $122^\circ 41\frac{1}{2}'$; space-group C_{2h}^2-C2/m . ρ is 4.17 and the unit cell contains $4[\text{Cu}_2\text{SO}_5]$. n_x is 1.715, n_y 1.820, and n_z 1.880 [H. Berman]. L. S. T.

Unusual occurrence of gypsum at Kalgoorlie, W. Australia. R. T. Prider (*Amer. Min.*, 1940, 25, 591—605).—Selenite encrustations have developed on the walls and roof above the apparent H_2O level of certain parts of the mine which appear to have existed as airlocks during flooding. The occurrences and crystallography are described, and the genesis of the encrustations is discussed. The deposits developed probably during a short period of several months while the mines were being unwatered and pressures in the airlocks decreasing. L. S. T.

Cristobalite in bentonite. J. W. Gruner (*Amer. Min.*, 1940, 25, 587—590).—X-Ray examination of two bentonites from Wyoming establishes the presence of cristobalite (I). A chemical analysis [R. B. Ellestad] indicates 30% of (I). The origin of the (I) is volcanic. L. S. T.

Optical evidence of polysynthetic twinning in arsenopyrite. J. S. Lukesh (*Amer. Min.*, 1940, 25, 619—621).—Determination of crystal structure shows that arsenopyrite is monoclinic and not orthorhombic. Twinning has been observed on polished sections of arsenopyrite under polarised light. L. S. T.

Cuprobismutite. C. Palache (*Amer. Min.*, 1940, 25, 611—613).—Cuprobismutite consists of a mixture of emplectite and bismuthinite. The name should be discarded.

L. S. T.

Nature of the ore-forming fluid. C. N. Fenner (*Econ. Geol.*, 1940, 35, 883—904).—A discussion of Graton's views (*A.*, 1940, I, 379), and a reply to his objections to the author's conception of the nature of the ore-forming fluid (cf. also *ibid.*, 161).

L. S. T.

Width of albite-twinning lamellæ. J. D. H. Donnay (*Amer. Min.*, 1940, 25, 578—586).—The width of albite-twinning lamellæ depends on the obliquity of the twin; the smaller is the obliquity, the higher is the frequency of the twin and the thinner are the lamellæ. The curve of obliquity plotted against composition shows that the lamellæ should be thinnest in oligoclase and increase in width slowly towards anorthite (I) and rapidly towards albite (II). Pure (I) and (II) should show disappearance of polysynthetic twinning. The results support the French theory of twinning.

L. S. T.

Rammelsbergite and parammelsbergite: distinct forms of nickel diarsenide. M. A. Peacock and A. S. Dadson (*Amer. Min.*, 1940, 25, 561—577).—Rammelsbergite (I) from Eisleben and Schneeberg is orthorhombic with a_0 3.53, b_0 4.78, c_0 5.78 Å.; space-group D_{2h}^{12} — $Pmmn$, ρ_{obs} 6.95, ρ_{calc} 7.05, and unit cell $2[\text{NiAs}_2]$. Structural data are similar to those of marcasite and not loellingite. A new chemical analysis of (I), and its behaviour towards etching agents, are recorded. In air saturated with H_2O , (I) is etched almost completely in 12 hr. Parammelsbergite (II) from three localities in Ontario is orthorhombic or pseudo-orthorhombic, apparent space-group D_{2h}^{12} — $Pbma$ or C_{2v}^2 — $Pb2a$, with a_0 5.74 \pm 0.01, b_0 5.81 \pm 0.01, c_0 11.405 \pm 0.03 Å., ρ_{obs} 7.12, ρ_{calc} 7.24, and unit cell $8[\text{NiAs}_2]$. Chemical analyses and behaviour towards etching reagents are recorded. (II) appears to decompose more rapidly than (I) in moist air. (I) and (II) are readily and best distinguished by their X-ray powder diagrams, which are reproduced.

L. S. T.

Geochemistry of quicksilver mineralisation. R. M. Dreyer (*Econ. Geol.*, 1940, 35, 905—909).—A reply to criticism (cf. *A.*, 1941, I, 62).

L. S. T.

Geology of the Highland Border from Glen Almond to Glen Artnay. D. A. Allan (*Trans. Roy. Soc. Edin.*, 1940, 60, 171—193).

L. S. T.

Morphological analysis of danburite. J. D. H. Donnay (*Trans. Roy. Soc. Canada*, 1940, [iii], 34, IV, 33—43).—The method described previously (*A.*, 1940, I, 150) is applied to danburite, and gives results in agreement with those obtained by X-ray analysis. Vals. predicted for a_0 , b_0 , and c_0 are 8.03, 8.74, and 7.71 Å., respectively.

L. S. T.

Certain biotite gneisses of the Grenville series near Kingston, Ontario. W. T. Love (*Trans. Roy. Soc. Canada*, 1940, [iii], 34, IV, 53—62).—Biotite gneisses and conditions of metamorphism are described. Four chemical analyses of the gneisses and one of biotite conc. from Grenville gneiss are presented.

L. S. T.

Ultrabasic rocks of the Fort Fraser map-area (west half), northern B.C. J. E. Armstrong (*Trans. Roy. Soc. Canada*, 1940, [iii], 34, IV, 21—32).—Two large areas of ultrabasic rocks are described. The rocks have been partly to completely serpentinised, and in many places have undergone later hydrothermal alteration to carbonate-quartz-mariposite and carbonate-talc rocks. Existing theories of origin, mode of emplacement, serpentinisation, and steatitisation of ultrabasic rocks are discussed.

L. S. T.

Oxide ores from the auriferous and argentiferous lead mine at Bolkardağ, Turkey. G. C. Ladame (*Schweiz. min. petr. Mitt.*, 1938, 18, 404—428; *Chem. Zentr.*, 1938, ii, 3670).—The deposits contain Pb 7—22% (as galena, cerussite, anglesite, mimetite, pyromorphite, and Pb-jarosite), Zn 1—7.8% (as blende, calamine, smithsonite, and aurichalcite), Cu 0.2, Fe_2O_3 30—54, MnO 1.5—2.5, SiO_2 5—23, As traces—1.3%, Ag 392—704, Au 2—13.6 g. per m. ton (in chalcocite and pyrites). Concentrates are obtained containing Pb 51—63%, Ag 1890—3200, Au 7—96 g. per m. ton.

A. J. E. W.

Mineralisations in the Guedmoua region. F. von der Weid (*Arch. Sci. phys. nat.*, 1940, [v], 22, Suppl., 133—136).—Five different deposits are described.

L. S. T.

Rare copper-cobalt mineral from the Meskani (Iran) deposit. M. Gysin and P. Kovaliv (*Arch. Sci. phys. nat.*, 1940, [v], 22, Suppl., 126—130).—The mineral is grey, and a fractured surface tarnishes rapidly in air until it is black. The blackening is accompanied by an increase in wt. The mineral, hardness 4, ρ 6.862—7.097 (powder), is readily fused by the blowpipe, giving off As fumes. Heated in an open tube it gives a mirror of As. It is sol. in HNO_3 , and contains Cu 59.43, Co 3.95, As 33.72, S 0.25, insol. 0.78, gangue (carbonates) 1.87%. Spectrographic examination confirms the absence of Sb, but shows the presence of traces of Fe, Ni, and Ti, also Sr, probably from the gangue. The mineral is a mixture of three anisotropic constituents, viz., hexagonal domeykite, Cu_3As , safflorite, CoAs_2 , and a small amount of cobaltite, CoAsS .

L. S. T.

Quartz monzonites from the valley of the Ak-Su, Anatolia. M. Gysin (*Arch. Sci. phys. nat.*, 1940, [v], 22, Suppl., 108—112).—Mineral analyses of 10 samples are recorded.

L. S. T.

Syenite-monzonite rocks from the north of Shéhine-Kara-Hissar, Anatolia. M. Gysin and H. N. Pamir (*Arch. Sci. phys. nat.*, [v], 22, Suppl., 105—108).—Mineral compositions of 6 samples are recorded. The rocks are similar in character to those from Divrik (Gysin, *Compt. rend. Soc. Phys. Hist. nat. Genève*, 1939, 56, 126).

L. S. T.

Mineralogical analysis of some marine sands of Anatolia. M. Gysin and P. Kovaliv (*Arch. Sci. phys. nat.*, 1940, [v], 22, Suppl., 84—89).—Magnetic and density separations of sands from the Ordu region, and the microscopical examination of the fractions obtained, are described, and the mineralogical compositions recorded. The average composition is magnetite 34.70, oligist (martite) 4.40, ilmenite 1.76, limonite 0.16, green pyroxene (I) 29.04, alkaline-earth carbonates 2.65, basic plagioclase (II) 14.13, miscellaneous 13.16%. The abundance of (I), (II), and lava debris, the scarcity of quartz, and the absence of tourmaline and F minerals show that these sands arise from the disintegration of basic volcanic rocks, principally andesites.

L. S. T.

Development of pseudo-stratification by metamorphic differentiation in the schists of Otago, New Zealand. F. J. Turner (*Amer. J. Sci.*, 1941, 239, 1—16).—The banded or laminated structure in the Palæozoic schists of the South Island, New Zealand, is a pseudo-stratification, and is mainly the result of metamorphic differentiation brought about by chemical mobilisation of the more readily sol. constituents of the rocks. Ten chemical analyses are discussed.

L. S. T.

American coal balls. W. C. Darrah (*Amer. J. Sci.*, 1941, 239, 33—53).—A large upper Pennsylvanian flora, containing >60 species, has been found in the coal balls in the Des Moines rocks of Iowa, Missouri, and Kansas. Species occurring in various mines and districts are tabulated. A chemical analysis [F. A. Gonyer] of a typical American coal ball is recorded. Pyrite (60%) and calcite (34%) are the main constituents; no dolomite is present. Org. matter (3.10%) is unexpectedly high.

L. S. T.

Radioactivity of sedimentary rocks and associated petroleum. K. G. Bell, C. Goodman, and W. L. Whitehead (*Bull. Amer. Assoc. Petroleum Geol.*, 1940, 24, 1529—1547).—Determinations of the radioactivity of 21 sedimentary rocks and 7 associated crude oils were made. The results corroborate the inferences of previous investigators that Rn tends to concentrate in crude oils. The amounts of radioactivity found in the oils examined are quantitatively sufficient to cause appreciable cracking by α -radiation during geologic time. These reactions, together with subsequent hydrogenation, may account for important changes in petroleum. This hypothesis would explain the presence of H_2 in some natural gases.

R. B. C.

Factors controlling pressure in petroleum reservoirs. J. S. Stewart (*Trans. Roy. Soc. Canada*, 1940, [iii], 34, IV, 123—134).—The origin and accumulation of petroleum, the development of reservoir pressure from hydrostatic causes, or wt. of overburden, or chemical action in the generation of petroleum from org. matter, and the control of pressure by seepage are discussed.

L. S. T.

BRITISH CHEMICAL AND PHYSIOLOGICAL ABSTRACTS

A., I.—General, Physical, and Inorganic Chemistry

MAY, 1941.

I.—SUB-ATOMICS.

Rendering visible and photographing of the Hertzian-wave region. V. K. Arkadiev and D. I. Penner (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 315—317).—Radiation of λ of ~ 1 cm. can be rendered visible or photographed by causing it to impinge on a photographic plate covered with a thin layer of Al, Cu, or Ni particles ~ 1 mm. length. Shaking the plate causes sparking between the metallic particles, which produces a photographic trace. L. J. J.

Selective absorption of light in interstellar space. A. Hunter (*Physical Soc. Rep. Progr. Physics*, 1940, 7, 150—159, and *Nature*, 1941, 147, 152—153).—A progress report and a review. L. S. T.

Distribution of energy in the visible spectrum of daylight. A. H. Taylor and G. P. Kerr (*J. Opt. Soc. Amer.*, 1941, 31, 3—8).—Spectral energy distribution between 4000 and 7000 Å., and colour temp., are recorded for direct sunlight and a variety of different types of sky, near Cleveland, Ohio. L. J. J.

The corona spectrum, June 19, 1936, at Omsk. G. Schain (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 778—781).—A spectrophotometric investigation of the corona as observed at the eclipse on this date has been made. The intensity of emission lines varies within large limits, absolutely and relatively, when passing from one region of the corona to another, and from one eclipse to another, as shown by comparison with data obtained from the 1929 eclipse. There is no proportionality between intensity of emission lines and that of the continuous spectrum with increasing distance from the solar limb, and with changing brightness of different regions of the corona. This can be explained in terms of the ionisation theory. There is evidence that a single source controls the equilibrium and excitation in the chromosphere, the protuberances, and the inner corona. A. J. M.

Breadth of spectral lines at large densities of a homogeneous gas. V. Fursov and A. Vlassov (*J. Physics, U.S.S.R.*, 1939, 1, 335—340).—The broadening of the resonance level caused by dipolar interaction between similar mols. in gases under pressure is calc. The results are not applicable to all spectral lines involving the resonance level, but to those which arise through transitions from upper levels to the resonance level, and to those corresponding with transition from a resonance to a metastable level. There is satisfactory agreement with experiment. A. J. M.

Theorem on nuclear motion in atomic spectra. J. P. Vinti (*Physical Rev.*, 1940, [ii], 58, 882—883; cf. A., 1940, I, 49).—Mathematical. The theorem derived concerns the energy shift of an at. level due to nuclear motion, and is in a suitable form for calculating isotope shifts when the radial wave functions are known only as numerical vals. N. M. B.

Isotope shift in boron. J. P. Vinti (*Physical Rev.*, 1940, [ii], 58, 879—881; 1941, [ii], 59, 103).—(A) Shifts reported by Mrozowski (cf. A., 1939, I, 289) are calc. with the aid of Morse-Young-Haurwitz wave functions (cf. A., 1936, 133). Results are -0.3665 cm. $^{-1}$ for either member of $\lambda\lambda$ 2497, 2498 of B I and $+0.566$ cm. $^{-1}$ for λ 3451 of B II, and their comparison with experiment and other data is discussed. The estimated possible spread due to nuclear spin is ~ 0.03 cm. $^{-1}$ in each case, explaining the absence of nuclear spin hyperfine structure in the spectrograms. (b) A correction. N. M. B.

Pressure effects of homogeneous rubidium vapour on its resonance lines. C. S. Yi (*Physical Rev.*, 1940, [ii], 58, 884—137 E 2 (A., I.)

887).—The broadening of the resonance lines of Rb in absorption up to 150 mm. pressure of its own homogeneous vapour was studied with a 21-ft. grating. For pressures < 1 mm. the broadening was very symmetrical, but at high pressures it showed van der Waals-type asymmetry. The $^2P_{1/2}$ component showed red, and the $^2P_{3/2}$ component violet, asymmetry. Both lines showed the proportionality of the width to concn. of Rb atoms. The experimental width at half-max. is greater by a factor 1.5 than that predicted by Houston's theory (cf. A., 1939, I, 50), and the width of the transition from $^2P_{3/2}$ is greater by a factor 1.6 than that from $^2P_{1/2}$. A narrow diffuse band was observed near the shorter- λ side of the $^2P_{1/2}$ component and a similar one near the longer- λ side of the $^2P_{3/2}$ component. N. M. B.

Influence of extraneous elements on line intensity. III. Effect of anions. W. R. Brode and E. S. Hodge (*J. Opt. Soc. Amer.*, 1941, 31, 58—63; cf. A., 1940, I, 329).—The effect of addition of a variety of anions, in the form of Ca or Ba salts, on the intensity of emission lines of Bi, Pb, Sb, Sn, Cd, and Zn oxides or carbonates mixed with CaCO_3 and excited by means of a C arc is recorded. Anions which tend to give subhalide band spectra show a greater effect in repressing line intensity than those which break down to CaO or BaO. The effect of CaF_2 is $>$ that of CaCl_2 . The effect generally increases with concn. of the test element, and in the case of CaF_2 approaches a max. with increasing $[\text{CaF}_2]$. In the absence of admixtures, for a series of salts with a common cation, the line intensity of the cation increases with the volatility of the salt or its decomp. products. L. J. J.

Hyperfine structure of ionised mercury lines. (A) L. Sibaiya. (b) S. Mrozowski (*Physical Rev.*, 1940, [ii], 58, 925; 1941, [ii], 59, 104).—(A) A comparison of the results of Mrozowski (cf. A., 1940, I, 138) with those independently obtained by Sibaiya.

(b) A discussion of the above.

N. M. B.

New lines and terms in the arc and first spark spectra of molybdenum: Mo I and Mo II. (Miss) M. R. Schauls and R. A. Sawyer (*Physical Rev.*, 1940, [ii], 58, 781—783).—The spectrum excited in a hollow-cathode discharge was photographed from 540 to 10,830 Å. The resonance triplet of Mo II, $^4S^{\circ}P^{\circ}$, was found, thus locating the lowest term, $^4S_{5/2}^{\circ}$, at 11,783.70 cm. $^{-1}$ below the previously known lowest level $^6D_{1/2}^{\circ}$. 20 new lines are classified, 7 new levels established, and 2 new multiplets, $^6D^{\circ}P^{\circ}$ and $^6D^{\circ}D^{\circ}$, arranged. 36 additional lines of Mo I are classified. N. M. B.

Interactions in the tungsten atom, W I, in a magnetic field. J. H. Roberson, J. E. Mack, and G. R. Harrison (*Physical Rev.*, 1940, [ii], 58, 895—902).—General expressions are deduced for the magnetic field dependence of the energies and intensities of neighbouring levels (regardless of coupling) of an atom. The energy dependence is tested experimentally for the levels 21,448, and 21,453, of W I and vals. for consts. are found. Discrepancies between calc. and observed energies are attributed to slight repulsive forces from other levels and disturbances of reference lines. N. M. B.

Comparison of X-ray absorption fine-structure for two elements in the same crystal. S. T. Stephenson (*Physical Rev.*, 1940, [ii], 58, 873—876).—The fine-structures on the short- λ side of the K X-ray absorption edges of Cu, Se, Br, Rb, Sr, and As in RbBr , SrBr_2 , CuSe , CuBr , ZnSe , AgBr , $\text{CuSeO}_4 \cdot 5\text{H}_2\text{O}$, CuHAsO_4 , and $\text{Cu}_3(\text{AsO}_4)_2 \cdot 4\text{H}_2\text{O}$, investigated with a focussing transmission spectrograph, are not identical for two elements in the same ionic crystal lattice, and some

are different even at 150 v. energy distances from the main edge. The fine-structure is influenced by factors other than crystal structure alone. N. M. B.

Measurement of the excitation potentials of the mercury atom by means of a photon counter. M. Djatschenko and V. Selegenev (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 19—21).—The excitation of Hg atoms by electrons of varying energy has been followed by means of a photon counter. The observed energy levels and ionisation potential agree with spectroscopic and photo-electric vals. O. D. S.

Photo-electric spectrophotometry and its uses in industry. W. D. Wright (*Physical Soc. Rep. Progr. Physics*, 1940, 7, 36—40).—A progress report. W. J.

Photo-electric efficiency of iron, cobalt, and nickel at different temperatures in the soft X-ray region. K. S. S. Iyer (*Current Sci.*, 1940, 9, 537—538).—Soft X-rays, freed from ions and electrons, were caused to strike a target (Fe, Ni, Co, or Cu) and the photo-electrons produced were attracted by an external shield maintained at 54 v. above the potential of the target. The photo-electric current was measured at temp. between 30° and 950°. The photo-electric sensitivity (ϕ) of Fe is const. up to $\sim 780^\circ$, then decreases by $\sim 10\%$ between 780° and 900°, and thereafter increases. The Curie point of Fe is $770 \pm 5^\circ$ and the $\alpha \rightarrow \beta$ transition occurs at this temp. whilst the $\beta \rightarrow \alpha$ transition occurs at 910° . Co and Ni give const. vals. of ϕ throughout the whole temp. range, showing no variation at Curie or transition points. W. R. A.

Photo-electric work functions of (100) and (111) faces of silver single crystals and their contact potential difference. H. E. Farnsworth and R. P. Winch (*Physical Rev.*, 1940, [ii], 58, 812—819).—A detailed account of work previously reported (cf. A., 1940, I, 50). The work functions determined photo-electrically by Fowler's method of analysis were compared with the contact p.d. measured by the Kelvin null method. When outgassed Ag is deposited by vaporisation on the crystal faces there is evidence that a more gas-free surface is obtained than by heating alone. Results are explained by postulating that long heating produced a stable gas configuration of a unimol. surface layer, and that the surface after deposition was mainly free from this gas. The work function in the latter case was less by 0.09 ± 0.03 v. N. M. B.

Energy losses attending field current and thermionic emission of electrons from metals. G. M. Fleming and J. E. Henderson (*Physical Rev.*, 1940, [ii], 58, 887—894).—Measurements in the same tube were made by observing the thermal e.m.f. in a junction from which the emission currents were drawn. No measurable temp. change was observed for field emission up to thermionic temp. For thermionic emission, temp. changes were observed which, when correlated with power losses from the filament as a function of temp., yield the val. 4.46 ± 0.09 v. for the work function of W. Results strongly support the view that in field emission the electrons escape by penetrating rather than by surmounting the surface potential barrier as in thermionic emission. An expression for the average net energy loss per electron emitted in thermionic and field current emission is deduced. N. M. B.

Temperature dependence of the work function of tungsten. (A) W. B. Nottingham. (B) J. G. Potter (*Physical Rev.*, 1940, [ii], 58, 927—928, 928).—(A) A criticism of Potter (cf. A., 1940, I, 1).

(B) A reply.

N. M. B.

Mechanism of spark discharge in air at atmospheric pressure. I. L. B. Loeb and J. M. Meek (*J. Appl. Physics*, 1940, 11, 438—447).—The inadequacy of the Townsend equation for explaining sparks in air at \sim atm. pressure is shown, and the mechanisms active in air at higher pressures are given. A quant. criterion for streamer formation leads to a quant. theory for spark breakdown in air at atm. pressure, and this accords with experiment and predicts departures from Paschen's law. The theory is applied to longer sparks at atm. pressures and the effect of the decrease in density of photo-ionisation in longer avalanches is considered. Resulting modification of Meek's mechanism (cf. A., 1940, I, 276) is discussed, and the mechanism is correlated with the passage of lightning discharges. N. M. B.

Neutralisation and ionisation on a thoriated tungsten surface. N. D. Morgulis, M. P. Bernadiner, and B. I. Djalovitzkaja (*J. Physics, U.S.S.R.*, 1940, 2, 25—38).—The neutralisation of

Cs and K and the ionisation of Cs, K, and Na at 1400°K. , and at 1700°K. for Na, on the surface of thoriated W at different degrees of activation (θ) or effective work functions (ϕ) have been investigated. With increasing θ the coeff. of neutralisation (i.e., the ratio of the no. of ions leaving to the no. of atoms striking the surface) increases whilst the coeff. of ionisation (i.e., the ratio of the no. of atoms striking to the no. of ions leaving the surface) decreases. Both processes are always determined by vals. of ϕ , undistorted by the contact field, which correspond with local vals. at spots where atoms or ions directly strike the surface and thus differ from the escape of electrons from the surfaces for which ϕ has an average val. over the entire surface. From detailed analysis of the experimental data the Th film on the W surface is considered to possess a non-uniform (spotted) surface. W. R. A.

Electrical discharges in gases and their applications. I. V. J. Francis and H. G. Jenkins (*Physical Soc. Rep. Progr. Physics*, 1940, 7, 230—302).—A progress report. W. J.

Excitation of atoms in a rare gas discharge. K. Panevkin (*J. Physics, U.S.S.R.*, 1940, 2, 39—48).—Existing theoretical and experimental data on the influence of current on concn. of excited atoms in rare-gas discharges (He, Ne, and Ar) are critically discussed. Existing data and probe measurements indicate that the dependence of concn. of excited atoms on current is determined by variation in the electron temp. with current. With increase of current the electron temp. falls but the electron concn. increases. The superposition of these two factors gives a max. for the no. of exciting collisions with a certain magnitude of current at which saturation concn. of the excited atoms occurs. Previous theories assume shortening of the life of excited atoms by collisions of a de-activating type whilst from the viewpoint presented the life is considered const. W. R. A.

Formation and maintenance of electron and ion beams. L. P. Smith and P. L. Hartman (*J. Appl. Physics*, 1940, 11, 220—229).—The radial potential distribution in an ionic beam of circular cross-section is calc. and the max. beam current which can be obtained with a beam of given radius and boundary conditions is derived. Methods of preventing divergence of an ionic beam during the initial acceleration process are discussed. O. D. S.

Acceleration of electrons by magnetic induction. D. W. Kerst (*Physical Rev.*, 1940, [ii], 58, 841).—Using a laminated electromagnet with 8 in. diameter pole faces and a 600-cycle per sec. magnetic field, electrons of estimated energy ~ 2.2 Me.v. were accelerated to produce X-rays by impact on a W target. The estimated electron energy prior to impact was ~ 2.25 Me.v. N. M. B.

Fresnel diffraction of electrons as a contour phenomenon in electron supermicroscope images. J. Hillier (*Physical Rev.*, 1940, [ii], 58, 842; cf. A., 1939, I, 433).—Photographs taken with an improved electron microscope show a new type of contour at the image of the line of separation of two areas of the specimen having widely different at. mass thicknesses, and similar in appearance to the diffraction effects with a light microscope. Their origin and explanation are discussed. N. M. B.

Radiation emitted by uniformly moving electrons. I. Tamm (*J. Physics, U.S.S.R.*, 1939, 1, 439—454; cf. A., 1937, I, 220).—Mathematical. The theory of the radiation emitted by an electron moving uniformly in a ponderable medium with velocity $>$ that of light in the medium is extended, and the effects of loss of energy by collisions, ionisation, etc. are considered. L. J. J.

Specific charge of the positron. A. H. Spees and C. T. Zahn (*Physical Rev.*, 1940, [ii], 58, 861—864; cf. A., 1938, I, 223).—Direct comparisons between electrons and positrons obtained from artificially radioactive Cu were made for β -particles of velocity $\beta = \sim 0.72$. Results indicate that e/m_0 for positrons is the same ($\pm 2\%$) as for electrons. N. M. B.

Mobility of positive ions in their own gas. R. J. Munson and A. M. Tyndall (*Proc. Roy. Soc.*, 1941, A, 177, 187—191).—The mobility of Ne^+ in Ne, Ar^+ in Ar, Kr^+ in Kr, and Xe^+ in Xe was measured. The mobilities can be calc. from the known mobilities of alkali ions in the gases; the observed val. is $<$ that calc., the difference being attributed to the phenomenon of electron exchange in the case of ions in their own gas. The variation of mobility with field E and pressure

ρ was studied. In Kr and Xe the mobility falls with rise of E/ρ . G. D. P.

Mobility of alkali ions in gases. IV. Measurements in gaseous mixtures. H. G. David and R. J. Munson. **V. Temperature measurements in the inert gases.** K. Hoselitz (*Proc. Roy. Soc.*, 1941, **A**, 177, 192—199, 200—204; cf. A., 1939, I, 544).—IV. In binary mixtures of inert gases the reciprocal of the mobility of alkali ions is a linear function of the concn. with the exception of Li^+ in He-Xe mixtures. With clustered Li^+ ions in mixtures of an inert gas and aq. vapour, deviations from the simple law are observed which increase with the density of the gas. The effect is ascribed to the increasing size of the clustered ion with increasing % of aq. vapour.

V. The temp. variation of the mobility of Li^+ in He, K⁺ in A, Rb⁺ in Kr, and Cs⁺ in Xe was measured over a range of temp. The results show that the approx. agreement with theory, previously found in the case of Cs⁺ and Na⁺ in He, is not general. G. D. P.

Negative-ion formation in iodine vapour by electron impacts. R. Buchdahl (*J. Chem. Physics*, 1941, **9**, 146—152).—The negative-ion formation in I vapour has been studied by Lozier's method (A., 1934, 1159) with electron velocities 0—7 e.v. The kinetic energies of the ions produced by electrons of different energies indicate that all are produced by the reaction $\text{I}_2 + e = \text{I}^- + \text{I}$. The probability of collision resulting in ionisation is 10^{-4} — 10^{-3} . The electron affinity of the I atom, calc. from the dissociation energy of the neutral mol. and the kinetic energies of the electrons and ions, is 3.0 ± 0.2 e.v. J. W. S.

Ferromagnetic anisotropy and the itinerant electron model. H. Brooks (*Physical Rev.*, 1940, [ii], **58**, 909—918).—Mathematical. The itinerant or collective electron concept in the theory of metals is applied, through Bloch's "approximation of tight binding," to explain the quenching of orbital angular momentum in solids, and, through the introduction of l, s coupling, ferromagnetic anisotropy in cubic crystals. The anisotropy appears in the fourth approximation and has the correct order of magnitude for Fe and Ni. A qual. discussion of the behaviour of Fe-Ni alloys is given. N. M. B.

Eleventh report of the committee on at. wts. of the International Union of Chemistry. G. P. Baxter, M. Guichard, O. Hönlischmid, and R. Whytlaw-Gray (*J.C.S.*, 1941, 146—151).—Recent work on the at. wts. of C, S, P, K, I, Cs, and Ho is summarised, and in the case of Ho the new val. 164.94 is adopted, the other at. wts. remaining unchanged. Attention is directed to discrepancies between chemical and mass-spectrographic vals. for Sc, Tb, Tm, Ir, and Au. F. J. G.

New radioactive transition series. W. Wahl (*Finska Kem. Medd.*, 1940, **49**, 88—92).—The mass-spectra of two (unspecified) U minerals contain a weak mass-line 237, which is absent from monazites and Varuträsk and Willberforce uraninites and thus cannot be a Th or U isotope. 237 must be a member of a new radioactive series, with end product ^{205}Pb or ^{209}Pb , and a faint line at 205 occurs in the spectra containing the 237 line. It is suggested that the atom responsible is ^{237}Pa derived from the hypothetical ^{241}U . M. H. M. A.

β -Radiation of radium-A and the formation of the element of nuclear charge 85. W. Minder (*Helv. Phys. Acta*, 1940, **13**, 144—152).—The increase of β -radiation of Ra emanation and its disintegration products with time has been determined up to 13 min. This increase is initially > that required by theory on the assumption that Ra-B and Ra-C are formed, but can be explained if it is assumed that a soft β -radiation from Ra-A is present. The latter is almost completely absorbed by material of 1 mm. air equiv. After the absorption, the remaining radiation agrees with that due to Ra-B + Ra-C. The β -radiation from Ra-A amounts to ~15% of that from Ra-B. If this β -radiation arises from Ra-A the element with at. no. 85 must be produced. The name *helvetium* (Hv) is proposed for it, but chemical identification has not yet proved successful. A. J. M.

Application of the coincidence method for measurements of short life periods. J. Rotblat (*Proc. Roy. Soc.*, 1941, **A**, 177, 260—271).—A method for the determination of radioactive life periods in the range 10^{-7} to 10^{-1} sec. is described. The half-life period of Ra-C' was found to be 1.45×10^{-4} sec.

Evidence was obtained for the absence of γ -rays in the transition $\text{Ra-C}' \rightarrow \text{Ra-D}$, and some conclusions regarding the lifetimes of excitation states of Ra-C' have been drawn. The application of the method to the determination of the intensity of weak sources and the efficiency of Geiger counters is discussed. G. D. P.

β -Decay. A. Zavelski (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, **29**, 12—15).—The continuous β -spectra of ^{32}P , Th-C'' corr. to $Z = 0$ by application of Fermi's theory (A., 1934, 579), and Ra-E corr. to $Z = 0$, and adjusted to the same upper limit of energy as ^{32}P and Th-C'', are compared with the curve deduced from Fermi's theory. All the spectra are less symmetrical than the theoretical curve, giving a greater no. of slow electrons. It is suggested that this variation is due to the dependence of the shape of the spectrum on the change in momentum of the nucleus. The unsymmetry is more pronounced in the order $^{32}\text{P} > \text{Ra-E} > \text{Th-C}'' >$ theoretical curve, i.e., in the order of the line in Sargent's diagram (A., 1933, 443) to which the elements belong. Comparison with other experimental data shows that these curves are typical for elements belonging to lines 3 (^{32}P), 2 (Ra-E), and 1 (Th-C'') of Sargent's diagram. O. D. S.

Anomalous scattering of neutrons by helium. II. H. Staub and H. Tatel (*Physical Rev.*, 1940, [ii], **58**, 820—828; cf. A., 1939, I, 171).—A closer investigation of the anomalous scattering by He of neutrons at ~1 Me.v. energy shows a backward scattering cross-section peak of 0.4 Me.v. half-width and indicates a doublet structure with a splitting of ~0.3 Me.v. The redetermined abs. ratio of He and H scattering cross-sections at 2.5 Me.v. neutron energy was \ll that previously found. The resulting lower abs. vals. of the resonance scattering cross-section are still consistent with the assumption of a P resonance level, and measurements agree with the dispersion theory. N. M. B.

Resonance scattering of protons and neutrons on helium. F. Bloch (*Physical Rev.*, 1940, [ii], **58**, 829—836; cf. preceding abstract).—Mathematical. A development of general dispersion theory in which the wave function describing a resonance process appears as a monochromatic Fourier component of a wave packet which is built in such a way that it represents for $t > 0$ the decay of a compound state and for $t < 0$ the building up of the same compound state. The method is applied to the resonance P scattering of protons and neutrons on He. N. M. B.

Capture cross-sections for thermal energy neutrons. II. F. Rasetti (*Physical Rev.*, 1940, [ii], **58**, 869—870; cf. A., 1940, I, 426).—The intensity of the β -activity induced under standard neutron irradiation is determined, and the no. of neutrons is measured by using as standard the activity induced in Mn. Data thus obtained are reported for slow neutron capture by ^{23}Na , ^{27}Al , ^{31}P , ^{41}K , ^{51}V , ^{63}Cu , ^{65}Cu , ^{75}As , ^{79}Br , ^{121}Sb , and ^{127}I . N. M. B.

Capture cross-sections for slow neutrons. K. Sinma and F. Yamasaki (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, **38**, 167—173, and *Physical Rev.*, 1941, [ii], **59**, 402—403).—From measurements of the intensity of β -rays from induced radioactive substances produced by neutron capture the relative capture cross-sections of 50 isotopes for slow neutrons have been determined and the abs. cross-sections have been calc. W. R. A.

Laws of nuclear structure derived from nuclear spins. S. Tolansky (*Nature*, 1941, **147**, 269; cf. A., 1936, 1040).—For stable atoms of odd at. wt. the three laws for nuclear structure are: (i) in stable at. nuclei with an odd nuclear neutron, the spin and angular momenta of the lightly bound or odd particle(s) tend to oppose each other, (ii) in stable at. nuclei with an odd nuclear proton, the addition of 2 neutrons does not alter the nuclear spin, and (iii) in stable at. nuclei with an odd nuclear neutron, the addition of 2 neutrons may increase the nuclear spin. As a corollary to (ii) it is stated that when 2 neutrons are added in presence of an odd proton, the neutrons set themselves with their spins in opposition. L. S. T.

Disintegration of ^{14}N and ^{15}N by deuterons. M. G. Holloway and B. L. Moore (*Physical Rev.*, 1940, [ii], **58**, 847—860; cf. A., 1939, I, 592).—A mixture of ^{14}N and ^{15}N was bombarded with 1-Me.v. deuterons and the ranges of the disintegration particles were measured with a shallow ionisation chamber and pulse amplifier. The shortest measurable range was

2.1 cm. (15° , 760 mm.). The reaction $^{15}\text{N} (d, \alpha) ^{12}\text{C}$ gave one group of α -particles (5.25 cm. range, $Q = 7.54$ Me.v.), and $^{14}\text{N} (d, \alpha) ^{12}\text{C}$ gave three groups of α -particles (11.97 cm., $Q = 13.39$; 6.54 cm., $Q = 9.02$; 3.47 cm., $Q = 5.77$ Me.v.). The reaction $^{14}\text{N} (d, p) ^{15}\text{N}$ gave two groups of protons (90.5 cm., $Q = 8.51$; 21.02 cm., $Q = 3.15$ Me.v.). A group previously reported at 66 cm. was due to B contamination. No proton groups due to $^{15}\text{N} (d, p) ^{16}\text{N}$ were found, although an activity of half-life 9.5 ± 1.0 sec. arose from deuteron bombardment of $^{14}\text{N} + ^{15}\text{N}$, but not from ^{14}N alone. N. M. B.

Gamma radiations emitted in nuclear processes. N. Feather (*Physical Soc. Rep. Progr. Physics*, 1940, 7, 66–86).—A progress report. W. J.

Short-lived radioactivities of ^{27}Si , ^{31}S , and ^{35}A . L. D. P. King and D. R. Elliott (*Physical Rev.*, 1940, [ii], 58, 846; cf. Barkas, A., 1940, I, 400).—Using 16-Me.v. α -particles, the following new reactions and half-lives have been observed: $^{24}\text{Mg} (\alpha, n) ^{27}\text{Si}$ (4.92 sec.); $^{28}\text{Si} (\alpha, n) ^{31}\text{S}$ (3.18 sec.); $^{32}\text{S} (\alpha, n) ^{35}\text{A}$ (1.91 sec.). Assignments by non-chemical means are discussed. N. M. B.

Long-lived isotope of yttrium. C. Pecher (*Physical Rev.*, 1940, [ii], 58, 843).—From Sr bombarded with 16-Me.v. deuterons from a cyclotron, radioactive Y (~ 100 days) was separated. It is probably ^{86}Y produced by a $1d-2n$ reaction from ^{88}Sr (cf. Du Bridge, A., 1940, I, 340), and emits a penetrating γ -radiation giving an absorption curve in Cu, Pb, and Fe almost identical with that of Ra γ -rays; it appears suitable for radiography. The yield is ~ 12 mg. Ra equiv. per 1000 μ -amp.-hr. of 16-Me.v. deuterons. N. M. B.

Electro-capillary theory of the splitting of heavy elements by slow neutrons. J. Frenkel (*J. Physics, U.S.S.R.*, 1939, 1, 125–136; cf. A., 1939, I, 398).—Mathematical. A theory of the splitting of a heavy nucleus into two parts of comparable size is developed by analogy with the instability of an electrically charged liquid drop. The drop becomes unstable when the ratio γ of its electrical to its surface energy reaches a crit. val. ~ 2.17 . For all known elements γ is < 2.17 but that of U probably approaches the crit. val. closely. It is shown that for $\gamma < 2$ the spherical shape is unstable. For arbitrary vibrations about the spherical shape of a liquid drop with a uniformly distributed vol. charge the frequency of the fundamental mode becomes 0 when γ reaches the val. 2. If the val. of γ is close to the crit. val. the energy of capture of a neutron may be sufficient to cause explosive rupture of the nucleus. The mechanism of this rupture is discussed. O. D. S.

Chemical nature of the radioactive fragments of thorium fission. Radioactive halogens. I. A. Polesitzki and M. Orbeli. II. A. Polesitzki and N. Nemerovski (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 215–216, 217–218).—I. On irradiation with fast neutrons, $\text{Th}(\text{NO}_3)_4$ yields two forms of radioactive I with half-life periods 1 and 15 hr., respectively (cf. Dodson and Fowler, A., 1939, I, 350). Evidence is obtained that the I of shorter life is formed from a Te isotope of half-life period 40 min.

II. By copptn. with inactive Te and subsequent distillations with KI and KNO_3 it is shown that ThCl_4 , after irradiation with fast neutrons, yields radioactive Te of half-life period 78 hr., which decays to give radioactive I of half-life period 2.4 hr. Subsequent distillation with KBrO_3 and KBr, reduction of the Br in Na_2SO_3 , and pptn. as AgBr shows the presence of two Br isotopes with half-life periods 45 min. and 4.5 hr., respectively. J. W. S.

Nuclear fission fragments as radioactive indicators of iodine exchange between silver iodide and solution of iodide. A. Polesitzki (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 441).—Radioactive I of half-life 15 hr. was obtained by the fission of Th by fast neutrons. This I was used to study the exchange of I between AgI and KI solution. There was a rapid exchange at the start which decreased considerably later. More "aged" AgI showed a much slower exchange.

mv/E relation for products of uranium fission. N. A. Perfilov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 426–428).—When U is bombarded with neutrons, comparatively highly charged particles are emitted. The magnitude of the charge can be determined by deflecting the particles in a magnetic field in vac. The trace of the deflected particles was obtained on a photographic plate with a thick emulsion,

in which tracks of protons failed to give a clear picture, and α -particles may be easily detected. The val. of mv/E was found to be 6.6×10^{-6} e.m.u. Assuming the energy vals. for the two recoil nuclei to be 91 Me.v. and 57 Me.v., respectively, and the masses 90 and 144, respectively, the effective charge is $20e$. A. J. M.

Heat of fission of uranium. M. C. Henderson (*Physical Rev.*, 1940, [ii], 58, 774–780; cf. A., 1939, I, 593; Turner, A., 1940, I, 340).—The heat produced during slow-neutron bombardment in a 13.36-g. sample of metallic U was measured on a resistance thermometer. Simultaneously the no. of fissions produced in a 54- μ g. layer of U was counted by an ionisation chamber and pulse amplifier. The vals. found were 40 μ -watts and 340 fissions per min., respectively, giving an average heat of fission of 177 Me.v. $\pm 1\%$ per fission. N. M. B.

Velocity-range relation for fission fragments. N. Bohr, J. K. Boggild, K. J. Broström, and T. Lauritsen (*Physical Rev.*, 1940, [ii], 58, 839–840; cf. A., 1941, I, 3).—Statistical analysis supports evidence obtained from range measurements of tracks and from the counting of branches at various parts of the range of a large no. of tracks in U targets that there are two broad groups of tracks with 22 and 29 cm. range in air, indicating the presence of two main groups of fragments, as shown in chemical analysis of the fission products but not clearly shown in the cloud-chamber tracks. Curves for the two groups are given. N. M. B.

Successive transformations in nuclear fission. N. Bohr (*Physical Rev.*, 1940, [ii], 58, 864–866; cf. A., 1940, I, 53).—Mathematical. Assuming that fission of heavy nuclei takes place in competition with the escape of a neutron from the highly excited compound system, fission of the residual nucleus after neutron escape would still be expected, for sufficiently high excitation of the system. Since conditions for competition with neutron escape are often more favourable in this second stage, such effects may give rise to much increased cross-sections for the fission process. N. M. B.

Deuteron-induced fission in uranium and thorium. I. C. Jacobsen and N. O. Lassen (*Physical Rev.*, 1940, [ii], 58, 867–868).—Determination by means of deuteron beams from a cyclotron of the variation with deuteron energy of fission yield for U and Th showed, in both cases, a rapid rise at 8–9.5 Me.v. For 9 Me.v. the estimated cross-section in U is 5×10^{-27} sq. cm., and for this energy the U-Th cross-section ratio is 0.7, supporting the theoretical expectation of successive transformations (cf. preceding abstract). N. M. B.

Identification of two radioactive xenons from uranium fission. C. S. Wu (*Physical Rev.*, 1940, [ii], 58, 926; cf. A., 1940, I, 187; Dodson, *ibid.*, 307).—Cs placed behind a Be target bombarded with 16-Me.v. deuterons gives an activity of half-life 5 days. Ba similarly treated gives activities of half-life 9.4 hr. and 5 days. Periods and absorption curves identify these with radioactive Xe from U and Th fission. The Cs reaction is assumed to be $^{133}\text{Cs} (n, p) ^{133}\text{Xe}$. Evidence is given that the Ba reactions are $^{138}\text{Ba} (n, \alpha) ^{133}\text{Xe}$ (5 days), and $^{138}\text{Ba} (n, \alpha) ^{134}\text{Xe}$ (9.4 hr.). Hence the two chains found in U and Th fission are identified as ^{133}Te (60 min.) \rightarrow ^{133}I (22 hr.) \rightarrow ^{133}Xe (5 days) \rightarrow ^{133}Cs , and ^{136}Te (~ 10 min.) \rightarrow ^{136}I (6.6 hr.) \rightarrow ^{136}Xe (9.4 hr.) \rightarrow ^{136}Cs (?). I (12.6 hr.) was separated from the fast-neutron-activated Cs, confirming the assignment ^{136}I resulting from the reaction $^{136}\text{Cs} (n, \alpha) ^{136}\text{I}$ (cf. Livingood, A., 1939, I, 54). N. M. B.

Production of secondary ionising particles by non-ionising agents in cosmic radiation. B. Rossi, L. Jánosy, G. D. Rochester, and M. Bound (*Physical Rev.*, 1940, [ii], 58, 761–766; cf. Schein, A., 1940, I, 308).—Experiments with various arrangements of counters show that the influence of the position of the absorber on the counting rate of a vertical counter arrangement near sea level is due mainly to scattering, knock-on showers, showers from the air, etc., rather than to penetrating non-ionising particles producing ionising secondary rays or to photons producing mesotrons. N. M. B.

Mean lifetime of the mesotron from electroscopie data. H. V. Neher and H. G. Stever (*Physical Rev.*, 1940, [ii], 58, 766–770).—Cosmic-ray intensities were measured at various depths in two lakes, one $\sim 12,000$ ft. above the other, but of the same geomagnetic latitude. The difference in depths of the two sets of measurements was about equal in mass to

the air between the lakes. Assuming air and H_2O to be g. for g. equiv. absorbers for the mesotrons involved, the ratio of intensities at equiv. points in the two lakes was calc., and by matching this with the observed ratios a val. 2.8×10^{-6} sec. for the mean rest lifetime of a rest mass of 160 times that of the electron was found. N. M. B.

Neher-Steuer experiment. E. Nelson (*Physical Rev.*, 1940, [ii], 58, 771—773).—Three problems important to the quant. interpretation of experiments (cf. preceding abstract) are discussed. The correct treatment of the altitude effect in the energy distribution is important in determining the decay const. of the mesotron. The fraction of mesotrons decaying is independent of the zenith angle. The absorption in H_2O of cascades produced by decay electrons, calc. from Serber's shower theory, agrees with experiment, showing that one but not both of the decay products is shower-producing. N. M. B.

Production of mesotrons by penetrating non-ionising rays. B. Rossi and V. H. Regener (*Physical Rev.*, 1940, [ii], 58, 837—838).—Experiments at 4300 m. above sea level with special arrangements of counters give definite evidence of the production of mesotrons by non-ionising rays (cf. Schein, A., 1940, I, 308), and indicate that the rays are more penetrating than photons and may be neutrettos (neutral mesotrons) or high-energy neutrons. N. M. B.

Effect of an eclipse on cosmic rays. A. H. Compton (*Physical Rev.*, 1940, [ii], 58, 841).—A preliminary statement claiming the existence of an observed effect. N. M. B.

Absorption of cosmic rays in lead at a depth of 1000 m. water equivalent. J. Barnóthy and M. Forró (*Physical Rev.*, 1940, [ii], 58, 844—845).—A repetition of experiments previously reported (cf. A., 1939, I, 351), but with 70 cm. of wood replacing a 2.5-cm. Pb shield, confirms a min. intensity at 10 cm. of Pb followed by an increase, and a second min. at 42 cm. of Pb. A qual. explanation is proposed by assuming that at such depths only a non-ionising radiation is present which produces secondaries with 10 cm. Pb range in the clay or brick layer and ionising secondaries with 25 cm. Pb range in Pb. The min. at 42 cm. of Pb is explained by assuming that in wood another kind of more penetrating particles with well-defined ranges of 40 cm. of Pb is created. These rays may be protons, and those in clay or Pb may be mesotronic. N. M. B.

Disintegration of atomic nuclei by cosmic rays. A. Filippov, A. Shdanov, and I. Gurevitch (*J. Physics, U.S.S.R.*, 1939, I, 51—65).—Tracks from the disintegration of nuclei with the emission of from 1 to 5 heavy particles have been observed on photographic plates with emulsion 50 μ . thick and are described. Showers of protons making small angles with one another and processes accompanied by the emission of protons and mesotrons have been observed. Calc. energies of disintegration are ~ 20 Me.v. for disintegration into three and > 60 Me.v. for disintegration into six particles. O. D. S.

Maximum energy which primary electrons of cosmic rays can have on the earth's surface due to radiation in the earth's magnetic field. I. Pomerantschuk (*J. Physics, U.S.S.R.*, 1940, 2, 65—69).—The radiation of the primary electrons of cosmic rays in the earth's magnetic field is considered. Calculation based on classical electrodynamics indicates that the radiation will play an important rôle beginning with electron energies of 10^{16} e.v. The electron energy, E_e , at the earth's surface is due to this radiation, related to its energy at infinity, E_0 , by $E_e = E_0 E_0 / (E_0 + E_e)$, where E_0 is $\sim 10^{17}$ e.v. and depends on geomagnetic latitude and the angle of incidence of the electron. The spectrum of primary electrons entering the earth's atm. may have energies $\sim 10^{17}$ e.v. due to radiation in the magnetic field. W. R. A.

Registration of mesotrons by means of thick-emulsion photographic plates. A. Shdanov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 110—114).—Tracks with abnormally widely spaced grains observed in photographic emulsions exposed to cosmic-ray showers are attributed to mesotrons. Their characteristics agree with mesotron properties as observed by Corson and Brode (A., 1938, I, 382). O. D. S.

Origin and nature of heavy ionisation particles detected on photographic plates exposed to cosmic rays. D. M. Bose and (Miss) B. Chowdhry (*Nature*, 1941, 147, 240—241).—Additional evidence that supports previous conclusions (A., 1940,

I, 341) is recorded. The component of the cosmic ray responsible for producing heavy ionisation tracks in photographic plates is more strongly absorbed in H_2O than in air; it is probably neutrons. L. S. T.

Radio echoes and cosmic-ray showers. P. M. S. Blackett and A. C. B. Lovell (*Proc. Roy. Soc.*, 1941, A, 177, 183—186).

Seasonal variations of cosmic-ray intensity and temperature of the atmosphere. A. Duperier (*Proc. Roy. Soc.*, 1941, A, 177, 204—216).—Examination of the upper atm. data shows that there is a lag in the warming of the atm. in spring which is correlated with diminution of intensity of cosmic rays. A similar though less marked phenomenon is found in autumn. The cosmic-ray variations are more closely connected with the mean temp. of the atm. up to 16 km. than with the temp. near the ground. This supports the view that the temp. variation of penetrating cosmic rays is related to the instability of the mesotron. G. D. P.

Bohr theory of nuclear reactions. R. Peierls (*Physical Soc. Rep. Progr. Physics*, 1940, 7, 87—106).—A progress report. W. J.

Ratio of e , c , and h . A. Landé (*Physical Rev.*, 1940, [ii], 58, 843).—If $a^2\pi$ is identified with $2\pi\phi$, i.e., $\gamma = (2\pi/3)^{1/2}$, where $a =$ "radius," and $\phi =$ the universal scattering cross-section, then α^{-1} (where $\alpha = e^2/ch = \mu/\gamma$) has the val. 137.1273 in exact agreement with experiment. The physical origin of the factor 2π is unexplained. N. M. B.

Calculation of force fields from scattering. F. C. Hoyt and W. E. Frye (*Physical Rev.*, 1940, [ii], 58, 784—786; cf. A., 1939, I, 304).—Mathematical. A method is developed for calculating the field which gives an observed scattering on the assumption that the interaction can be represented by a central field and that the phase shifts can be calc. by the WKB approximation. Application to electronic and nuclear scattering is discussed. N. M. B.

Elastic scattering in helium at 15° . R. L. Mooney (*Physical Rev.*, 1940, [ii], 58, 871—873).—Mathematical. Margenau's interaction energy is used in a form modified for small vals. of the separation parameter, and an angular distribution function is obtained for the scattered intensity of head-on collisions of parallel beams of He atoms with relative velocities appropriate to 15° . The scattering curve does not show the regularity obtained in smooth-sphere model calculations, but the expected max. at 90° is present. The calc. total collision cross-section is 1228×10^{-16} , and the diffraction cross-section is 34.21×10^{-16} compared with the viscosity cross-section 14.93×10^{-16} sq. cm. N. M. B.

Possible Kronig fine-structure in X-ray emission spectra. S. T. Stephenson (*Physical Rev.*, 1940, [ii], 58, 877—878; cf. A., 1941, I, 138).—A comparison with Kronig K-absorption fine-structure for Cu shows that weak Cu emission bands observed extending 34 X. out on the short- λ side of Cu $K\beta_2$ are caused by absorption of the X-rays while emerging from the Cu target. N. M. B.

Gaseous model of atomic nuclei. J. Frenkel and V. Tscherdincev (*J. Physics, U.S.S.R.*, 1940, 2, 55—64).—Theoretical. By treating heavy at. nuclei as a degenerated Fermi gas composed of protons and neutrons, a relation between at. wt. and at. no. has been determined quantitatively. The no. of stable isobars and isotopes has also been determined. Deviation of electric density from a const. val. is insignificant. The size of nuclei is found from the condition of energy min. using a Yukawa potential, and an estimation of the thermal expansion coeff. and the relaxation time is attempted. The possibility of the existence of intranuclear α -particles is considered, and it is concluded that in all heavier nuclei protons are practically all passed into such particles. W. R. A.

Scattering of α -particles by light nuclei. V. V. Maljarov (*J. Physics, U.S.S.R.*, 1940, 2, 75—80).—Theoretical. The anomalous scattering in ^4He and ^{12}C is explained by the existence of compound systems in two excited states. W. R. A.

Classical theory of the scattering of mesons. D. Ivanenko (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 411—414).—The theory is developed by the introduction of a Hertz vector. The motion of a heavy nucleus is described non-relativistically, the quasi-electric part of the momentum tensor and the magnetic part of the total polarisation tensor

being neglected. Formulae are deduced for the quasi-electric and quasi-magnetic scatterings on the assumption that the nucleons are point particles. A generalisation of the theory is proposed in the form of a non-linear theory. This leads to the introduction of quasi-electric and magnetic nuclear form factors, making scattering at small angles more probable. The experiments of Bothe and Schmeiser on hard showers seem to indicate the existence of such small-angle scattering.

Scattering of mesons. A. Sokolov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 16—18).—Mathematical. The scattering of neutral mesons by free nucleons (*i.e.*, heavy particles, proton + neutron) is discussed.

Quantum theory of emission of elementary particles. A. Sokolov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 415—417).—A consistent theory describing the emission of photons for which the energy, $h\nu$, is known to equal the product of impulse, $h\nu/c$, and velocity of light, c ($\omega = c\nu$), can be developed on the basis of quantum mechanics. The case where $\omega < c\nu$ is now dealt with.

II.—MOLECULAR STRUCTURE.

Two new electron levels of CO. V. M. Tschulanovski (*J. Physics, U.R.S.S.*, 1939, 1, 341—346).—The spectrum of CO from 1000 to 1300 Å. has been analysed and discussed. Two band-systems ${}^1\Sigma \rightarrow {}^1\Sigma$ ($\nu_{00} = 90,866 \text{ cm}^{-1}$) and ${}^1\Pi \rightarrow {}^1\Sigma$ ($\nu_{00} = 98,791 \text{ cm}^{-1}$) were found, and their vibrational and rotational constns. calc.

Interaction of various components of a ${}^3\Sigma$ with a ${}^1\Pi$ level. B. L. Stepanov (*J. Physics, U.S.S.R.*, 1940, 2, 81—88).—The form of the matrix elements of interaction between the levels ${}^1\Pi$ and ${}^3\Sigma$ has been investigated particularly with respect to the perturbations of the level $v = 0$ in the ${}^1\Pi$ state of CO.

Shape of perturbation curves for the intersection of levels ${}^3\Sigma$ and ${}^1\Pi$ of the diatomic molecule. B. L. Stepanov (*J. Physics, U.S.S.R.*, 1940, 2, 89—95).—The approximation given by Kovacs and Budo (A., 1938, I, 602) for the intersection does not always hold. At the point of intersection of two levels a third level exerts a distorting effect.

Band spectrum of germanous sulphide in emission. R. F. Barrow (*Proc. Physical Soc.*, 1941, 53, 116—119; cf. A., 1940, I, 343).—The band spectrum of GeS, previously known only in absorption, was excited in emission by means of a heavy-current uncondensed discharge through a mixture of S and GeO₂ in a SiO₂ tube, in presence of Al. Data for ~20 new bands in the region λ 3350—3750, assigned to the long- λ end of the main system of GeS, are tabulated. Analysis confirms available absorption data.

Vibration analysis of the chlorine dioxide absorption spectrum. J. B. Coon (*Physical Rev.*, 1940, [ii], 58, 926—927; cf. Ku, A., 1933, 1102).—Replacing the fundamental frequency of 528 cm^{-1} by 447 cm^{-1} which appears as a const. difference in three separate pairs of progressions, a new analysis of the electronic band system at 2600—5225 Å. in ClO₂ absorption is reported. All distinct bands excluding isotope bands are grouped into 12 progressions; all other reported bands are classed as sub-bands, or are in the ultra-violet where predissociation causes confusion.

Infra-red spectra of polyatomic molecules. H. Nielsen (*Physical Soc. Rep. Progr. Physics*, 1940, 7, 41—65).—A progress report.

Absorption spectra of chrome alums at low temperatures. D. L. Kraus and G. C. Nutting (*J. Chem. Physics*, 1941, 9, 133—145).—The line absorption spectra of single crystals of 13 Cr sulphate and selenate alums have been measured at 85° and 15° or 20° K. over the λ range 6250—6900 Å. The majority show a strong doublet, together with fainter lines, near 6700 Å. In another class the spectrum is shifted towards longer λ and the doublet is replaced by strong sharp line at ~6900 Å., whilst a third class has ~6 strong lines near 6700 Å. These differences are correlated with the lattice structure consequent on the varying sizes of the univalent cations. Transitions which disrupt the lattice, causing the crystal to become opaque, occur in $\text{NH}_4\text{Cr}(\text{SO}_4)_3$, $12\text{H}_2\text{O}$ and $\text{NH}_4\text{Cr}(\text{SeO}_4)_3 \cdot 12\text{H}_2\text{O}$ at $81^\circ \pm 1^\circ$ and $106^\circ \pm 5^\circ$ K., respectively. Combinations of the electronic frequencies of Cr^{+++} with internal oscillations of anions are weak, but combinations

of lattice vibrations with both the upper and lower electronic states of Cr^{+++} are observed. In all cases bands occur shifted ~330, 570, and 800 cm^{-1} to higher frequencies than the electronic absorption lines. These are attributed to photo-excitation of a non-homopolar complex, probably $\text{Cr}(\text{H}_2\text{O})_6^{+++}$.

Infra-red transmission of thin films of various organic materials. A. J. Wells (*J. Appl. Physics*, 1940, 11, 137—140).—Data are recorded between 400 and 3000 cm^{-1} for Cellophane, ethylcellulose, cellulose acetate, Duco household cement, polystyrene, glyptal, Pliofilm, rubber, Plexiglas, Me methacrylate polymer, XYSG Vinylite, and Shawinigan V-15 resin. The possibility of using these materials for windows in spectroscopic work is discussed.

Features and implications of the near infra-red absorption spectra of various proteins. Gelatin, silk fibroin, and zinc insulinate. (Miss) J. D. Bath and J. W. Ellis (*J. Physical Chem.*, 1941, 45, 204—209).—Studies of oriented silk fibroin fibres with plane-polarised infra-red light show that the C=O bonds are generally perpendicular to the fibre axis. A similar examination of Zn insulinate crystals yields little support for the cyclol hypothesis of insulin structure but favours a configuration of the type $>\text{NH}\cdots\text{O}=\text{C}<$.

Effect of serum-proteins on light absorption by phenol-red in phosphate buffer solution.—See A., 1941, III, 300.

Precise spectrophotometric constants for haemochromogens and cytochrome c on an iron basis, and analysis of the cytochrome c spectrum. D. L. Drabkin (*J. Opt. Soc. Amer.*, 1941, 31, 70—72).—Fe in haemin and cytochrome c (I) can be accurately determined in ~10-mg. samples of 50% (I) by treatment with dil. NaOH and H₂O₂, conversion of the Fe into its *o*-phenanthroline complex after reduction with ascorbic acid at p_{H} 4.2—4.3, and spectrophotometric or photometric comparison of the complex with standard Fe preps. Extinction coeffs. are recorded for (I) and dipyrindinoferroporphyrin. Reduced (I) gives absorption max. at λ 5520, 5220, 4150, 3520, 3130, 2735, 2480, and 2240 Å.

Binding between molecules and intramolecular complexes of certain phenols, and the dispersion of absorption bands. M. I. Batuev (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 423—425).—PhOH and its derivatives are very suitable for studying the H bond between mols. and between atoms of the same mol. The band due to OH in the spectrum of *o*-C₆H₄Cl·OH is distinguished from that due to OH in PhOH and *p*-C₆H₄Cl·OH, as in the *o*-compound it is possible for a closed ring to exist in consequence of the H bond. *o*-C₆H₄Cl·OH exists in a *cis*- and a *trans*-form. The presence of mols. of the latter form is shown by asymmetry of the microphotogram of the OH band.

Spectrophotometric study of thionine. L. F. Epstein, F. Karush, and E. Rabinowitch (*J. Opt. Soc. Amer.*, 1941, 31, 77—84).—Data are recorded for the absorption spectra of 4 forms of thionine and 3 forms of leucothionine between 2300 and 9700 Å. as a function of concn. Beer's law is followed in solutions containing the free base and tervalent ions. Dimerisation of the univalent ion causes deviations at p_{H} 2—10.

Raman spectrum of *m*-diphenylbenzene. S. K. Mukerji and J. A. Aziz (*Phil. Mag.*, 1941, [vii], 31, 231—239).—The Raman spectrum of molten *m*-C₆H₄Ph₂ resembles that of the *o*-compound (A., 1938, I, 555). With λ 4358 as the exciting line, filtered through conc. NaNO₂ solution, the continuous spectrum due to fluorescence is much reduced, and 27 new Raman lines were observed. The most prominent frequency is at 1309 cm^{-1} , and is the characteristic frequency due to the C—C binding of the C₆H₅ rings. This is also present in Ph₂ and in *o*-C₆H₄Ph₂, but is absent in C₆H₆. Another strong frequency is at 1597 cm^{-1} , and is due to the C:C linking. The spectrum is discussed in connexion with the spectra of C₆H₆, Ph₂, and *o*-C₆H₄Ph₂.

Raman spectra of some ethers containing one or more phenyl groups. M. J. Murray and F. F. Cleveland (*J. Chem. Physics*, 1941, 9, 129—132).—Raman frequencies and their relative intensities and depolarisation factors are recorded for PhOPr^a, PhOBu^a, CH₃Ph·OEt, CH₃Ph·OBu^a, and (CH₃Ph)₂O. Intense frequencies, characteristic of Ph groups, with const. vals. in the series are 618, 1001, 1029, 1156, 1176, 1588, 1604, and 3058 cm^{-1} . The frequency 2911 cm^{-1} , which is strong for the compounds containing Pr or Bu

groups, appears to be more characteristic of the C chain than of the Me group (cf. Fox and Martin, A., 1940, I, 282). The frequencies 440, 900, and 1125 cm^{-1} may be characteristic of the C—O—C linking. J. W. S.

Scattering of light and relaxation phenomena in liquids. E. Gross (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 786—791).—The region of continuous spectrum of light scattered by liquids, termed the Rayleigh line background, has been investigated. The causes responsible for it differ from those which give rise to the wings, and it is a phenomenon characteristic of the liquid state. It is quite distinct from the rotational Raman spectrum, and cannot be attributed to free rotation of mols. in the liquid. It is more probably due to changes in orientation of mols. which are optically anisotropic. The effect is considered in relation to Debye's theory of thermal waves, and the conception of a relaxation time is introduced. Theory shows that this should be identical with the relaxation time used by Debye in the theory of dielectric properties of liquids in high-frequency fields. The intensity of the background should depend on the optical anisotropy of the mols., its extent in the spectrogram of the scattered light being determined by η , temp., and size of mols. This is in agreement with experiment. A. J. M.

Constitution of zinc beryllium silicate phosphors. G. R. Fonda (*J. Physical Chem.*, 1941, 45, 282—288).—Experiments have been carried out to show that the incorporation of Be in the Zn_2SiO_4 lattice is hindered on the one hand by the limitation in the mutual solubility of Be_2SiO_4 and Zn_2SiO_4 as a result of which fluorescence changes are confined to the composition range within which a homogeneous solution exists, and on the other hand by the natural sluggishness of the diffusion of oxides through the silicate layers which surround the reacting particles. The solubility of Be_2SiO_4 in Zn_2SiO_4 is decreased in presence of Mn. The fluorescence intensity of Zn—Be phosphors decreases linearly with increase in Be content until a crit. concn. is reached, after which the intensity falls off irregularly. Fluorescence is essentially a function of the double silicate and is not appreciably affected by the pure Be_2SiO_4 phase which acts more or less as a diluent up to the crit. concn. referred to. C. R. H.

Behaviour of willemite under electron bombardment. E. R. Piore and G. A. Morton (*J. Appl. Physics*, 1940, 11, 153—157).—A method of measuring p.d. between a willemite screen under electron bombardment and the accelerating electrode is described. Under scanning bombardment, the screen potential shows local variations of the order of thousands of v., varying with scanning frequency and c.d. The light intensity is \propto a power >1 of the accelerating voltage. L. J. J.

Origin of radiation of long and short duration in phosphors with an organic activator. V. L. Levschin and V. N. Tugarinov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 115—119).—The dependence of the intensity of fluorescence I_f and of phosphorescence I_p of a phosphor showing both phenomena on the intensity I_e of exciting radiation is discussed. I_p tends to saturation as I_e is increased. If the same centres are responsible for fluorescence as for phosphorescence, I_f will also tend to saturation with increasing I_e , but if different centres are effective, I_f will continue to increase with I_e after I_p has reached saturation. The variation of I_f and I_p with I_e for uranine— H_2BO_3 phosphors has been measured. At vals. of I_e sufficient to produce saturation in I_p , I_f continues to increase with I_e . It is concluded that different centres are responsible for fluorescence and phosphorescence. O. D. S.

Second-order colours. A. Porai-Koschitz and C. Moerder (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 139—143).—The theory of Strauss and Zeime (A., 1913, i, 992) that the anomalous colour change of dyes, apparent movement of absorption bands to shorter $\lambda\lambda$ on increase of mol. wt. or introduction of a second auxochrome in the α - or β -position, is due to simultaneous movement to longer $\lambda\lambda$ of two absorption bands (from ultra-violet to visible and from visible to near infra-red respectively) has been tested by an investigation of the infra-red spectrum of some dyes showing such anomalous colour change. No bands in the near infra-red have been observed in the spectra of those compounds in which anomalous colour change has taken place on increase of mol. wt. or introduction of a second auxochrome. O. D. S.

Fluorescence of aqueous solutions of rare earth salts. I. Fluorescence of aqueous solutions of terbium. A. Seidel, J. Lariourov, and A. Filippov (*J. Physics, U.S.S.R.*, 1939, 1, 67—77).—The fluorescence of solutions of Tb sulphate, chloride, and bromide has been investigated. The optimum region of excitation is between 210 and 230 $\text{m}\mu$. The fluorescence consists of seven narrow bands of $\lambda\lambda$ 681, 670, 648, 621, 589, 544, and 488 $\text{m}\mu$. The wave nos. of the bands agree with the hypothesis that the fluorescence is due to transitions from a single term of the $4f^8$ configuration to all the components of the ground term $^7F_6, 5, 4, 3, 2, 1, 0$ of Tb IV. The fluorescence shows an appreciable afterglow lasting >0.001 sec. The fluorescence may be used for the analytical determination of Tb. O. D. S.

Spectra of fluorescence and absorption of complex molecules. D. Blochintzev (*J. Physics, U.S.S.R.*, 1939, 1, 117—124).—Mathematical. The relation between the absorption and the fluorescence spectrum of a complex mol. is investigated. The "law of mirror images" (A., 1931, 1351) would be expected to hold at temp. T for the frequency range E/h , where E is the average mol. energy at temp. T . O. D. S.

Fluorescence, phosphorescence, and photochemistry of dyes. J. Franck and R. Livingston (*J. Chem. Physics*, 1941, 9, 184—190).—It is assumed that an electronically excited dye mol. can pass, by internal conversion, to the electronic ground state of a reactive tautomeride, the endothermic reversion of this tautomeride to the electronically excited state of the original mol. explaining the weak, temp.-dependent phosphorescence observed in some systems. Alternatively, in the presence of a reducing agent, the reactive tautomeride may yield a semiquinone. Most dye-sensitised photo-oxidations and the photo-bleaching of dyes by reducing agents can be explained on this theory. The rapid reversible bleaching of chlorophyll can be explained by assuming that the tautomeride and a normal mol. undergo a process of disproportionation. J. W. S.

Possibility of interpreting phenomena of polarised luminescence using linear-oscillator model. VII. V. L. Levschin (*J. Physics, U.S.S.R.*, 1939, 1, 265—275).—All the experimental data available on polarised luminescence can be satisfactorily interpreted by the aid of a simple linear-oscillator model. Formulae are deduced expressing polarisation as a function of temp., λ of exciting light, and viscosity of solvent. A. J. M.

Products of ionisation by electron impact in methyl and ethyl alcohol. C. S. Cummings and W. Bleakney (*Physical Rev.*, 1940, [ii], 58, 787—792).—Using a special all-metal mass-spectrograph, 14 different ions in MeOH and 25 in EtOH were observed. Appearance potentials and modes of dissociation were in some cases determined. Ionisation potentials were: MeOH 10.8 and EtOH 11.3 v. In each unambiguous interpretation the reaction requiring the least dissociation energy occurred. Results support the concept of localised charge on the O atom in certain complex ions. N. M. B.

Pressure of electronic gas and thermal conductivity of metals. M. Satō (*Sci. Rep. Tôhoku*, 1940, 29, 304—314).—Theoretical and mathematical. On the assumption that thermal conductivity in metals can be considered to be derived from a pressure gradient of electronic gas, it is shown that conductivity in metals is a similar phenomenon to that in gases and follows the principles enunciated by Sommerfeld, Lorentz, and Einstein. A. R. P.

Ionic mobilities in insulating liquids. A. Gemant (*Physical Rev.*, 1940, [ii], 58, 904—908).—Mathematical. A simple method is developed for computing mobilities from conductivity-time curves obtained after application of a d.c. potential. The ionic radii and the concn. of the corresponding particles can be calc. from the mobilities obtained. Application of the method to some available data for mineral oils gives ionic mobilities of $\sim 10^{-7}$ cm. per sec. per v. per cm. N. M. B.

Thermodynamics of irreversible processes. III. Relativistic theory of the simple fluid. II. A correction. C. Eckart (*Physical Rev.*, 1940, [ii], 58, 919—924, 924; cf. A., 1940, I, 406).—III. Mathematical. Modifications consistent with the special theory of relativity are introduced. The first law of thermodynamics is shown to be a scalar equation, and not the fourth component of the energy-momentum principle. Temp. and entropy are also shown to be scalars.

Simple relativistic generalisations of Fourier's law of heat conduction and of the laws of viscosity are obtained from the requirements of the second law. The accepted relativistic form of Ohm's law is confirmed.

II. A correction (cf. *ibid.*).

N. M. B.

Light effect in chlorine under electrical discharge. S. S. Joshi and V. Narasimhan (*Current Sci.*, 1940, 9, 535—537).—Two phenomena (A and B) occur with Cl_2 in an electric discharge and to a smaller extent with mixtures of H_2 and Cl_2 , and of H_2 and HCl . A refers to the slow diminution with time of the discharge current at a given applied potential; its recovery after discontinuing the current and its "ageing," accelerated by light, show time lags. B is instantaneous and refers to the diminution of current on irradiation. The magnitudes, characteristics, and interpretation of both phenomena are discussed.

W. R. A.

Contact resistance of semi-conductors. B. Davidov (*J. Physics, U.S.S.R.*, 1939, 1, 167—174).—Mathematical. The space charge at the surface of a semi-conductor due to a contact p.d. between the semi-conductor and the adjacent electrode will produce a change in the concn. of free electrons or, in the case of a semi-conductor with positive-hole conduction, of holes at the surface. The resulting field and contact resistances are calc. If these resistances have the right sign a "barrier-layer effect" will be produced at the surface and will lead to rectification.

O. D. S.

Electrical conductivity of metals. J. Bardeen (*J. Appl. Physics*, 1940, 11, 88—111).—A survey of current theory.

L. J. J.

Intermolecular sharing of hydrogen. E. B. R. Prideaux (*Chem. and Ind.*, 1941, 145—146).—The physical properties of liquid mixtures of monocarboxylic acids and N bases, and their solutions in C_6H_6 , indicate combination without ionisation. This is possible, without 5-covalent N, if a co-ordinate link is formed between the N atom as donor and the acid H atom as acceptor.

F. J. G.

Intermolecular sharing of hydrogen. G. E. Coates (*Chem. and Ind.*, 1941, 185).—The occurrence of divalent H in liquid salts of piperidine and aliphatic acids (cf. Prideaux, preceding abstract) is considered unlikely; first-order perturbation calculations show that the H^- ion is unstable with respect to H by 39 kg.-cal. per g.-atom. Normal H-bond formation by resonance between $\text{R}\cdot\text{CO}_2\text{H}$, $\text{NH}\cdot\text{R}$ and $\text{R}\cdot\text{CO}_2^-$, $\text{H}\cdot\text{NH}\cdot\text{R}$ is possible.

A. J. E. W.

Ferromagnetic domains and the magnetisation curve. W. F. Brown (*J. Appl. Physics*, 1940, 11, 160—172).—An account of the domain theory of ferromagnetism.

O. D. S.

Notation for the derivatives of the two types of line integral in thermodynamics. G. Tunell (*J. Chem. Physics*, 1941, 9, 191—192).—It is suggested that differentials of functions (e.g., work and heat) which depend on the path through which a system passes should be presented with a subscript indicating the plane in which the line integral is being differentiated, e.g., $(dW/dT)_s$.

J. W. S.

Kinetics of phase change. III. Granulation, phase change, and microstructure. M. Avrami (*J. Chem. Physics*, 1941, 9, 177—184; cf. A., 1940, I, 122, 223).—Mathematical. The author's theory is generalised and it is shown that a comprehensive description of the phenomena of phase change may be summarised in phase change, grain no., and microstructure formulae or diagrams, giving the transformed vol., grain, and microstructure densities, respectively, as a function of time, temp., and other variables.

J. W. S.

Theory of van der Waals molecules. R. Heller (*J. Chem. Physics*, 1941, 9, 154—163).—The mutual potential between two normal state atoms or groups forming a van der Waals mol. can be expressed in the form $V(R) = A e^{-R/\rho} - c_1/R^6 - c_2/R^8 - c_3/R^{10} - c_4/R^{12}$, where A and ρ are positive consts. and R is the variable distance between the centres of positive charge. Using this function, the vibrational wave nos. and energies of dissociation of HgHe , HgNe , HgAr , HgKr , HgXe , Hg_2 , $(\text{O}_2)_2$, and $(\text{NO})_2$ in the normal state are calc. With $\rho = 0.28$ Å. satisfactory agreement is obtained with experimental data excepting for $(\text{NO})_2$, in which the binding is probably partly due to first-order attractive forces.

J. W. S.

Coriolis perturbations and molecular dimensions in germane, GeH_4 . T. Y. Wu (*J. Chem. Physics*, 1941, 9, 195).—The discrepancy between the observed structure of the ν_4 fundamental of GeH_4 and the structure calc. by Murphy (A., 1940, I, 94) is attributed to the use of a low val. of the moment of inertia (I). Assuming pure valency and deformation forces in the mol., and from the observed val. of $\Delta\nu_3$, the calc. val. of I is 9.77×10^{-40} g.-cm. instead of 7.0 g.-cm. as calc. from $\Delta\nu_3$ and $\Delta\nu_4$. This val. leads to a Ge—H distance 1.49 Å., in accord with the Si—H distance in SiH_4 .

J. W. S.

Relation between structure and free energy of organic molecules. P. F. Bruins and J. D. Czarnecki (*Ind. Eng. Chem.*, 1941, 33, 201—203).—The free energy (ΔF°) equation for the formation of a C—H bond is obtained by dividing by 4 the ΔF° equation for the formation of CH_4 . From the former equation and the ΔF° equation for the formation of C_8H_{18} , the ΔF° equation for the formation of a C—C bond can be obtained. Continuing the process the ΔF° equations for the formation of $\text{C}=\text{C}$, $\text{C}-\text{Me}$, $\text{C}-\text{OH}$, $\text{C}-\text{CHO}$, and $\text{C}-\text{CO}_2\text{H}$ bonds can be similarly obtained. Unlike equations written in terms of the no. of C atoms, these bond equations can be used in more than one series of hydrocarbons. The equations are sufficiently accurate for most engineering problems.

C. R. H.

Surface tension. R. C. Brown (*Physical Soc. Rep. Progr. Physics*, 1940, 7, 180—194).—A progress report.

W. J.

Surface energy and surface entropy. A. Ferguson and E. J. Irons (*Proc. Physical Soc.*, 1941, 53, 182—185).—The total molar surface energy ΔE and molar surface entropy ΔS , when defined by $\Delta E = \mu - T\partial\gamma/\partial T$ and $\Delta S = -\partial\mu/\partial T$, where μ is free molar surface energy, are consts. independent of temp., and are connected by $T_c \Delta S = \Delta E$, where T_c is the crit. temp. ΔE , so defined, is identified with E_0 , the zero val. of the molar surface energy of the supercooled liquid. Calc. and experimental data for 23 liquids are tabulated and plotted.

N. M. B.

Nuclear gyromagnetic ratios of the chlorine isotopes. E. F. Shrader, S. Millman, and P. Kusch (*Physical Rev.*, 1940, [ii], 58, 925).—The mol.-beam magnetic resonance method is applied to LiCl prepared from HCl enriched to ~50% in ^{37}Cl (cf. A., 1940, I, 428), and the resonance min. obtained confirm the previously assigned g vals ^{35}Cl (0.546) and ^{37}Cl (0.454) (cf. A., 1939, I, 590). Assuming 5/2 for the spin of ^{37}Cl , the moment is 1.135 nuclear magnetons.

N. M. B.

III.—CRYSTAL STRUCTURE.

Formation of true X-ray images by reflexion on crystal mirrors. L. von Hámos (*Z. Krist.*, 1939, 101, 17—29).—The use of a cylindrically bent crystal as a mirror forming real images of X-ray sources is described. The conditions of formation, magnification, and distortion of the image are considered for a point or plane source coplanar with the cylinder axis and the centre of the reflecting surface. The image quality is best when the source is on or near the cylinder axis. The effect of geometrical aberration on the resolving power is relatively small, and may be diminished by reducing the aperture of the mirror, but the chromatic aberration is ~0.1% of the crystal radius, even with typical "monochromatic" X-radiation.

A. J. E. W.

Characteristic elastic vibrations of crystals under mixed boundary conditions. H. Wierzejewski (*Z. Krist.*, 1939, 101, 94—116).—The Sommerfeld-Ortvay method of determining characteristic vibrations (cf. *Ann. Physik*, 1913, [iv], 42, 745) is developed by resolution of the vibrations into superposed trains of plane elastic waves. The nature of these waves in an infinite crystal is considered, and the conditions of reflexion are examined for a crystal with a single plane boundary and a cryst. plate. The theory is then extended to crystals of different symmetry types.

A. J. E. W.

Line broadening of deformed metals. U. Dehlinger and A. Kochendörfer (*Z. Krist.*, 1939, 101, 134—148).—Vals. of the width of the Debye-Scherrer lines of Cu foil of different degrees of rolling ($R\%$) are recorded graphically. The effects of lattice deformations and grain-size ($\Delta = \sim 400$ Å. for all R vals.) are resolved; other effects are excluded by the method of measurement (cf. A., 1938, I, 127). Lattice deformations of cosine form, which may vary rapidly with a period of $\sim 2\Delta$ or so slowly that they are sensibly homogeneous within

each particle, cause a continuous displacement of the lines, the max. val., which defines the edges of the line, being \propto the Bragg angle. The separate effects of rapidly and slowly changing deformations can be resolved only by measurements of other properties (e.g., magnetic coercive force). The max. change of lattice const. increases rapidly with R up to $R = 30$ and then more slowly to $\sim 0.2\%$ at $R = 100$, corresponding with a bending amplitude of $\sim 0.1\text{A}$. The tensions caused by the deformations are $\sim 40\text{--}50$ kg. per sq. mm.

A. J. E. W.

Line broadening by lattice distortions of cosine form. A. Kochendörfer (*Z. Krist.*, 1939, 101, 149—155; cf. preceding abstract).—The variations of intensity and form of Debye-Scherrer lines due to lattice deformations of cosine form are examined theoretically. The deformations produce a splitting of each line into two symmetrically-disposed components, of which the form and separation are considered for deformation regions of different size ranges.

A. J. E. W.

Intensity distribution in Debye-Scherrer lines. F. Lihl (*Z. Krist.*, 1939, 101, 193—229).—The intensity distribution in monochromatic Debye-Scherrer lines, photographed under given conditions, is discussed in relation to the geometry of the apparatus and absorption in the specimen, the effects of which are specified by a "geometrical factor," G . Formulae are derived by which the intensities for any diffraction angle can be calc. for a specimen having high or very low absorption; data for a specimen of given absorption coeff. can be derived graphically. Typical intensity distribution curves for single lines are given.

A. J. E. W.

Interpretation of Laue photographs in terms of the reciprocal lattice. Correction. C. C. Murdock (*Z. Krist.*, 1939, 101, 271; cf. A., 1938, 1, 500).

A. J. E. W.

Diffuse reflexion of X-rays. G. D. Preston (*Nature*, 1941, 147, 358—359).—The formula derived by Jauncey (A., 1941, I, 102) and the geometrical significance of Faxén's formula are discussed. The physical interpretation of the latter is that the surfaces of const. intensity surrounding the Bragg points are spheres. The pattern given by Al (A., 1939, I, 553) conforms to this rule, and verifies Faxén's formula.

L. S. T.

Crystallographic calculations and constructions with the reciprocal lattice. W. F. de Jong and J. Bouman (*Z. Krist.*, 1939, 101, 317—336; cf. A., 1938, I, 234, 299, 604, 644; 1939, I, 306; 1940, I, 100).—A detailed account of the properties, construction, and use of the reciprocal lattice, illustrated by typical calculations for babingtonite and gypsum.

A. J. E. W.

Calculation of generalised lattice potentials. G. Molière (*Z. Krist.*, 1939, 101, 383—388).—Mathematical. A generalisation of Ewald's method (*ibid.*, 1921, 56, 129), by which generalised Madelung consts. (cf. A., 1939, I, 515) can be calc., is developed.

A. J. E. W.

X-Ray study of "crystalline boron." F. Halla and R. Weil (*Z. Krist.*, 1939, 101, 435—450; cf. A., 1939, I, 185 and Náray-Szabó, A., 1937, I, 16).—A detailed examination of specimens of the "graphite-like" form of AlB_{12} , obtained from pure Al and from reguli containing much Cu, shows the existence of two modifications, for which full morphological and crystallographic data, including reciprocal lattices, are given. From rotation and Weissenberg X-radiograms, the monoclinic modification (I) has a 8.50 \AA , b 10.98 \AA ; the crystallographic measurements are referred to a face-centred cell with all faces occupied, which has c 9.40 \AA , β 110° 54', but the true unit cell, containing 4 mols., has only one face filled, with c' 7.37 \AA , β' 143° 29', V 410.0 cu. A.; ρ 2.577; space-group C_{2h}^2 — C_{2h}^2/m , C_2^2 — Cm , or C_2^2 — $C2$. Modification (II) is tetragonal-pseudocubic, with a 10.28, c 14.30 \AA (tetragonal), or a 14.50, c 14.30 \AA (pseudocubic); V 1512 cu. A.; ρ 2.660; 16 mols. in unit cell; space-group C_4^2 — $I4_1$, D_4^2 — $P4_1$, or D_4^2 — $P4_1$. Comparison of structural data with analyses shows that the lattice of (II) has a deficit of ~ 12 atoms per 16 mols.; the weaker binding of electrons which form linkings across the gaps causes strong light absorption. The colour of black diamonds may have a similar cause. The region of homogeneity of AlB_{12} extends considerably to the B side of this composition.

A. J. E. W.

Oxide phases with a defect oxygen lattice. L. G. Silén and B. Aurivillius (*Z. Krist.*, 1939, 101, 483—495; cf. A., 1939, I, 412).—By X-ray analysis, the tetragonal $\text{PbO-Bi}_2\text{O}_3$ phase

(homogeneity range Pb 29—53 at.-% of metal atoms) has a 4.05—3.96, c 4.90—5.19 \AA . (33—53 at.-% Pb); ρ 9.33—9.29 (33—50 at.-% Pb); 2 metal atoms in unit cell; space-group D_{2h}^{14} — $P4/nmm$. Rotation and Weissenberg photographs show a superstructure involving a 6-fold increase in a . The metal atom positions, which form a distorted cubic face-centred lattice, are derived by inspection of intensities; the possible O atom positions in the "full" (MO_2) structure are fixed by space-filling considerations, and the parameters confirmed by calc. intensities. The rhombohedral $\text{SrO-Bi}_2\text{O}_3$ phase (14—26 at.-% Sr) has a primitive cell with a 9.63—9.80 \AA , α 23.8—23.4°, or a triply primitive hexagonal cell with a 3.97, c 28.06—28.59 \AA ; ρ 8.09—7.45 with 14.6—25 at.-% Sr; 3 metal atoms in unit cell; space-group D_{3d}^5 — $R\bar{3}m$. Details of the "full" structure, which has a layer lattice, are given. In both phases the actual O atom positions are obtained by removal of the appropriate no. of O from the "full" structure; the missing atoms appear to be evenly distributed over the possible types of lattice position. The metal atom lattice is the stabilising factor in the structure. The homogeneity limits do not correspond with rational compositions.

A. J. E. W.

Crystal structure of strontium bromide. M. A. Kamermans (*Z. Krist.*, 1939, 101, 406—411).—Three modifications of SrBr_2 have been obtained. Evaporation of a solution of anhyd. SrBr_2 in EtOH at $>40.5^\circ$ affords needle crystals, for which rotation X-radiograms give a rhombic unit cell, containing 4 mols., with a 9.20, b 11.43, c 4.3 \AA (needle axis); ρ_{calc} , 3.65; ρ_{obs} , ~ 3.8 ; space-group $Pbmm$ — D_{2h}^{16} . At. parameters derived by inspection of intensities are confirmed by calc. intensity vals. The structure is similar to that of PbBr_2 .

A. J. E. W.

Crystal chemistry of the silicates. I. Náray-Szabó (*J. Hung. Chem. Soc.*, 1940, 1, No. 3, 1—4).—A review of the development of crystal chemistry in general and of structure of the silicates in particular, with description of theories by Häuy, Bravais, Laue, Goldschmidt, and Bragg.

E. V. A.

Crystal structure of Ni_3Ti and Si_2Ti ; two new types. F. Laves and H. J. Wallbaum (*Z. Krist.*, 1939, 101, 78—93; cf. A., 1940, I, 67).—Powder X-radiograms and rotation photographs show that Ni_3Ti has a 5.096, c 8.304 \AA , c/a 1.630; 4 mols. in unit cell; ρ 7.80; space-group D_{6h}^{14} . The structure is a modification of hexagonal close packing such that if $ABAB\dots$ and $ABCABC\dots$ denote the arrangements of layers in true hexagonal and cubic close-packing, respectively, the arrangement in Ni_3Ti is $ABACABAC\dots$. Each Ti adjoins 6 Ni in the same layer and 3 Ni in each adjacent layer. Si_2Ti has a 8.236, b 4.773, c (pseudohexagonal) 8.523 \AA ; 8 mols. in unit cell; ρ 4.02; space-group D_{2h}^{14} . Si_2Ti has a rhombically deformed diamond lattice; each Ti adjoins 6 Si in the same layer, but is in contact with only 2 Si in each adjacent layer. At. parameters and interdistances are tabulated for both structures. The particles in Si_2Ti powder show a strong tendency to assume a preferred orientation, which is prevented by embedding the powder in a synthetic resin. The structures are compared with those of Mg_2Cd , Ni_3Sn , Si_2Mo , and Si_2W .

A. J. E. W.

Unit cell and space-group of caesium cupric chloride. D. P. Mellor (*Z. Krist.*, 1939, 101, 160—161).—Laue and oscillation photographs show that the orthorhombic unit cell of Cs_2CuCl_4 , containing 4 mols., has a 9.69, b 12.33, c 7.58 \AA ; ρ 3.42; space-group D_{2h}^{14} — $Pnam$ (or possibly C_{2h}^2). Cs_2CuCl_4 is not strictly isomorphous with $(\text{NMe}_4)_2\text{CuCl}_4$. The latter has a 12.11, b 15.50, c 9.05 \AA ; ρ 1.38; 4 mols. in unit cell; space-group probably D_{2h}^{14} — $Pnam$.

A. J. E. W.

Crystal structure of scandium trifluoride. W. Nowacki (*Z. Krist.*, 1939, 101, 273—283).—Powder X-radiograms show ScF_3 to have a 5.667, c 7.017 \AA , c/a 1.24 (hexagonal axes), or a 4.022 \AA , a 89° 34'5" (rhombohedral axes) (cf. A., 1939, I, 64); ρ_{calc} , 2.59; ρ_{obs} , 2.52. The structure contains 1 Sc at (000) and 3 F at $(\frac{1}{2}\pi\bar{x}\frac{1}{2})$, with $x = 0.025\text{--}0.030$. Each Sc is surrounded by 6 F in a slightly deformed octahedral configuration. The F—F distance is now given as 2.72—2.70 \AA . With slight idealisation the structure corresponds with the idealised WO_3 type; it resembles the structures of FeF_3 , CoF_3 , RhF_3 , and PdF_3 (cf. Wooster, A., 1933, 214) more closely than that of AlF_3 .

A. J. E. W.

Crystal structure of thallous sulphide, Tl_2S . J. A. A. Ketelaar and E. W. Gorter (*Z. Krist.*, 1939, 101, 367—375).

—Powder, rotation, and oscillation photographs indicate that Ti_2S has a hexagonal unit cell, containing 27 mols., with a 12.20, c 18.17 Å., c/a 1.490; $\rho_{\text{calc.}}$ 8.39; $\rho_{\text{obs.}}$ 8.40; space-group $C_3^2-R\bar{3}$. Considerations of packing, cleavage, and intensity grouping of the X-ray lines show that the structure, with slight idealisation, is of the layered PbI_2 (C_6) type; it is closely related to the structure of $\alpha\text{-Ti}$. At. parameters and interdistances, which are in accord with the Goldschmidt at. radii, are tabulated. A. J. E. W.

Crystal structure of TiSe , thallos thallic or thallosic selenide. J. A. A. Ketelaar, W. H. t'Hart, M. Moerel, and D. Polder (*Z. Krist.*, 1939, 101, 396–405).—From rotation, oscillation, and powder X-radiograms, the tetragonal unit cell of TiSe contains 8 mols. and has a 8.02, c 7.00 Å., c/a 0.873; $\rho_{\text{calc.}}$ 8.31; $\rho_{\text{obs.}}$ 8.175; space-group D_{2h}^{18} . A general study of the observed X-ray intensities gives at. parameters, which are confirmed by calc. intensity vals. The structure shows that TiSe should be formulated $\text{Ti}^{III}[\text{Ti}^{IV}\text{Se}_2]$. The Ti^{III} and Se atoms are covalently linked to form chains of tetrahedra, $\begin{array}{c} \text{Se} \\ \diagup \quad \diagdown \\ \text{Ti} \quad \text{Se} \\ \diagdown \quad \diagup \\ \text{Se} \end{array} \text{Ti} \begin{array}{c} \text{Se} \\ \diagup \quad \diagdown \\ \text{Ti} \quad \text{Se} \\ \diagdown \quad \diagup \\ \text{Se} \end{array} \text{Ti} \dots$, which lie parallel to the c -axis. Each Ti^{III} ion is surrounded by 8 Se. TiSe and TiSe_2 are the only intermediate phases in the system Ti-Se . A. J. E. W.

Magnetic anisotropy of cupric selenate pentahydrate. A. Mookherji and M. T. Tin (*Z. Krist.*, 1939, 101, 412–417).—Magnetic anisotropy vals. (for method of measurement cf. A., 1937, I, 20) are recorded for different orientations of the crystal. $\text{CuSeO}_4 \cdot 5\text{H}_2\text{O}$ has nearly uniaxial magnetic symmetry, with the axis parallel to the direction of min. χ . The principal susceptibilities are α 1140, β 1410, γ 1420 $\times 10^{-6}$ c.g.s. units at 28°; the directions of the magnetic axes are determined. A. J. E. W.

Crystal structure of hydrated potassium chlorostannite. H. Brasseur and A. de Rassenfosse (*Z. Krist.*, 1939, 101, 389–395; cf. Cox *et al.*, 1937, I, 118).—From analysis of oscillation X-radiograms, the orthorhombic unit cell of $\text{K}_2\text{SnCl}_4 \cdot \text{H}_2\text{O}$, containing 4 mols., has a 8.21, b 12.05, c 9.10 Å.; ρ 2.583; space-group D_{2h}^{18} — $Pbmm$. Complete at. parameters, derived from a Fourier–Patterson–Harker diagram for $z = 0$, are given. SnCl_4 groups do not exist as such in the structure, since each Sn is surrounded by 6 Cl in a nearly regular octahedron; the octahedra share edges parallel to (001) and extend in columns parallel to the c -axis. A. J. E. W.

Space-group of 1:3:5-trinitrobenzene crystal. S. L. Chorghade (*Z. Krist.*, 1939, 101, 376–382).—Rotation and oscillation photographs show that the orthorhombic unit cell, containing 16 mols., has a 12.77, b 26.97, c 9.74 Å.; ρ 1.69; space-group Q_h^{16} ($Pcab$). Indexed estimated intensities are given. A. J. E. W.

Crystal structure of chloranil. S. L. Chorghade (*Z. Krist.*, 1939, 101, 418–424).—From rotation X-radiograms, the monoclinic prismatic crystals of $\text{C}_6\text{O}_2\text{Cl}_4$ have a 8.77, b 5.78, c 17.05 Å., β 103.5°; ρ 1.933; 4 mols. in unit cell; space-group $P2_1/a$ (C_2^2). Indexed visually-estimated intensities are tabulated. The structure has pseudo-orthorhombic symmetry with (201) as a plane of symmetry, in accordance with magnetic data (Banerjee, A., 1939, I, 409). A. J. E. W.

X-Ray crystallography and chemistry of the steroids. J. D. Bernal (Miss) D. Crowfoot, and I. Fankuchen (*Phil. Trans.*, 1940, A, 239, 135–182).—The X-ray crystallography of 87 derivatives is surveyed: 38 of the cholesterol series [5 hydrocarbons, 1 monoketone, 8 (OH) $_1$, 5-polyhydroxy- and keto-compounds, 5 ethers, 6 mono- and 8 poly-halogen derivatives], 14 of the ergosterol series (2 hydrocarbons, 6 mono-, and 4 poly-hydroxy-derivatives, and 2 maleic anhydride adducts), 15 photo-derivatives of ergosterol (6 lumisterol, 7 calciferol, and 2 suprasterol derivatives), and 20 higher plant and animal steroids [13 (OH) $_1$ -compounds, 5 acetates, and 2 esters]. The unit cell size, space-group, and data on the morphology and optics have been determined. Patterson projections have been derived from intensities of the X-ray reflexions of the h_0l planes for cholesteryl chloride, bromide, and chloride hydrochloride and prove that the mols. are approx. lath-shaped, $20 \times 7 \times 4$ Å. Several different crystal structures are encountered and a general geometric classification is attempted which indicates the main groups of monoclinic crystals. The crystallographic data are discussed in

their bearing on sp. chemical problems—characterisation and identification, mol. wt. determinations, stereochemistry of the C skeleton, effect of substituents on the crystallography of the sterols, comparison of the crystallography of different monohydroxy-sterols. Calciferol shows certain differences from the characteristic sterol group and certain similarities which indicate that the actual distribution of atoms in the mol. resembles that in ergosterol. W. R. A.

X-Ray studies on tuberculin proteins.—See A., 1941, III, 386.

Isomorphism and miscibility of organic compounds. I. Isomorphous replacement of hydrogen, the hydroxyl, amino-, and methyl groups, and chlorine in the crystal lattice of naphthalene. A. Neuhaus (*Z. Krist.*, 1939, 101, 177–192).—Data for 2- $\text{C}_{10}\text{H}_7\text{X}$ (X = OH, NH_2 , Me, Cl, respectively) are as follows: a 8.14, 8.60, 7.8, 7.65; b 5.92, 6.00, 5.98, 5.93; c 18.2, 16.75, 18.6, 18.4 Å.; β 119° 48', \sim 115.5°, 103° 16', \sim 103°; V 761, 782, 844, \sim 815 cu. Å.; $\rho_{\text{calc.}}$ 1.249, 1.208, \sim 1.10, 1.326; $\rho_{\text{obs.}}$ 1.245, —, 1.103, 1.266. Certain interplanar distances and morphological, goniometric, and optical data are also given. Among the above compounds and C_{10}H_8 the only pair for which true isomorphism is established is 2- $\text{C}_{10}\text{H}_7\text{Me}$ and - $\text{C}_{10}\text{H}_7\text{Cl}$, so that the effects of the substituents on the cell dimensions cannot be compared. The structures differ in the angle between the longer mol. axis and the c -axis. A. J. E. W.

Zinc oxide smoke. G. D. Preston (*Nature*, 1941, 147, 298).—A photograph, obtained by means of the electron microscope, confirms the finding that some of the particles of ZnO smoke are in the form of needles (cf. A., 1941, I, 104). The small crystals constituting the smoke are \sim 4500 Å. long and $>$ 450 Å. thick; the apparent length of the crystals is remarkably uniform. L. S. T.

Molecular anisotropy of carbamide, and of related compounds. K. Lonsdale (*Proc. Roy. Soc.*, 1941, A, 177, 272–282).—The magnetic anisotropy of $\text{CO}(\text{NH}_2)_2$ was measured and compared with that of CO_3^{2-} and NO_3^- ; the relatively large optical anisotropy shows that the NH_2 group is more polarisable than the O ion. X-Ray, magnetic, and optical observations show that carbamide nitrate (I) and oxalate (II), cyanuric acid dihydrate (III), and anhyd. cyanuric acid all crystallise in layer structures; unit cell dimensions were determined. The magnetic anisotropy of (I) and (II) is approx. additive but that of (III) is $>$ the val. for three $\text{CO}(\text{NH}_2)_2$ mols. It is concluded that although the mols. in each layer must be joined by H bonds the links between successive layers are not necessarily H bonds. G. D. P.

New method of obtaining the N pattern of electron diffraction. S. Yamaguchi (*Nature*, 1941, 147, 296).— N patterns are obtained from films prepared by allowing chemical reactions to take place under controlled conditions. A thin film of H_2O or 12*N*-HCl is first obtained by immersing and withdrawing Pt wire gauze in the solution. Such films are brought into contact with clean K or Ca which give on the gauze films of KHCO_3 or $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ suitable for transmission electron diffraction experiments. Patterns for single crystals of these two substances are reproduced; that for KHCO_3 gives a 15.4 and b 5.72 Å., compared with a_0 15.01 and b_0 5.69 Å. given by X-rays. L. S. T.

Magnetic and other properties of the free electrons in graphite. N. Ganguli and K. S. Krishnan (*Proc. Roy. Soc.*, 1941, A, 177, 168–182).—Graphite crystals have a large free-electron diamagnetism directed almost wholly along the hexagonal axis. In the temp. range 90–1270° K. the diamagnetism per C atom is found to be equal to the Landau diamagnetism of a free electron gas obeying Fermi–Dirac statistics and having a degeneracy temp. of 520° K. It is concluded that there is one free electron per C atom in graphite closely bound to a basal layer but free to migrate in that layer. The result is considered in terms of the Brillouin zones of the graphite crystal. G. D. P.

Temperature variation of magnetic anisotropy of a bismuth crystal. W. J. John (*Z. Krist.*, 1939, 101, 337–344).—The principal susceptibilities of a 99.998% pure Bi crystal parallel and perpendicular to the trigonal axis are $\chi_{11} = -1.05 \times 10^{-6}$ and $\chi_{\perp} = -1.45 \times 10^{-6}$ at 27°. The anisotropy ($\chi_{11} - \chi_{\perp}$), measured directly by Krishnan and Banerjee's method (A., 1935, 924), decreases linearly with temp. from 0.402 $\times 10^{-6}$ at 27° to 0.09 $\times 10^{-6}$ at 260°; it then remains approx.

const. up to the m.p., 271.1° . A less pure specimen has $\chi_{11} - \chi_{\perp} = 0.43 - 0.135 \times 10^{-8}$ at $27-260^\circ$, with a rapid fall near the m.p., 270° . A. J. E. W.

Magnetic texture and magneto-elastic hysteresis. M. Dechtjar (*J. Physics, U.S.S.R.*, 1939, 1, 159—166; cf. A., 1939, I, 309).—The change in susceptibility of undeformed crystals of meteorite ferro-nickel Fe (Ni 8, Co 0.5%) after demagnetisation under tension has been investigated. The effect is most marked at low field strengths. Hysteresis curves showing the change in intensity of magnetisation with applied force for normal crystals and for those demagnetised under tension have been obtained and are correlated with the domain theory of ferro-magnetism. O. D. S.

Anisotropy of hysteresis in ferromagnetic single crystals. II. J. S. Schur (*J. Physics, U.S.S.R.*, 1940, 2, 5—10; cf. A., 1938, I, 182).—The invalidity of previous investigations of the anisotropy of hysteresis in single crystals is demonstrated. The anisotropy of the coercive force (H_c) is measured for a no. of single-cryst. discs of Si steel, cut without mechanical deformation and annealed with magnetic shielding. The results show (a) considerable anisotropy of H_c , (b) max. and min. vals. of H_c dependent directly on the crystallography of the specimen, and (c) that when the magnetic properties of the specimen are made worse the disposition of the max. and min. relative to the crystallographic axes is maintained. In order to obtain commercial ferromagnetics with the smallest hysteresis losses it is considered that (i) the polycryst. material should approach as closely as possible the single-cryst. state, (ii) the texture of the material should be such that in normal working conditions the magnetic field would lie along the direction in which the energy of anisotropy is a min., and (iii) the material should possess large individual grain size. Calc. and experimental vals. of H_c agree satisfactorily (cf. following abstract). W. R. A.

Theory of the technical magnetisation curve in ferromagnetic single crystals. Anisotropy of the coercive force. S. V. Vonsovski (*J. Physics, U.S.S.R.*, 1940, 2, 11—18).—A general qual. explanation of the anisotropy of the coercive force, H_c , in single-crystal discs of Fe is advanced. A quant. explanation of the anisotropy of min. vals. of H_c is given. Existing experimental data are reviewed and compared with theory. W. R. A.

Energy of magnetic anisotropy and critical field of a ferromagnetic cooled in a magnetic field. S. V. Vonsovski (*J. Physics, U.S.S.R.*, 1940, 2, 19—23).—The energy of magnetic anisotropy of ferromagnetics cooled in (a) "weak" magnetic fields which give rise to the inversion part of the magnetisation curve and (b) "strong" fields to which are attributed the part of the curve corresponding with the rotation process have been calc. from existing theoretical data (A., 1938, I, 69). Theoretical expressions for the change in magnetisation work (ΔU) for polycrystals in "strong" and "weak" fields are deduced and for "weak" fields theoretical and experimental vals. of ΔU are approx. equal. The influence of cooling in a magnetic field on the magnitude of the critical field is calc. W. R. A.

Directional dependence of electrical conductivity. E. M. Baroody (*Physical Rev.*, 1940, [ii], 58, 793—804).—Mathematical. From the theory of conductivity a provisional theory of directional dependence in metallic crystals is developed and applied to simple models. N. M. B.

Crystal structure of Rochelle salt (sodium potassium tartrate tetrahydrate, $\text{NaKC}_4\text{H}_6\text{O}_6 \cdot 4\text{H}_2\text{O}$). C. A. Beevers and W. Hughes (*Proc. Roy. Soc.*, 1941, A, 177, 251—259; cf. A., 1940, I, 350).—The structure has been determined by Fourier and Patterson analysis. In the tartrate mol. the four C atoms lie in one plane; the remaining atoms are so disposed that each half of the mol. lies in a plane inclined at 60° to the plane of the C atoms. The tartrate mols. are bonded to Na and K atoms both directly and through the medium of H_2O mols. Vals. of the cell parameters are given for the isomorphous NH_4Na and RbNa salts. G. D. P.

Properties of Rochelle salt. IV. H. Mueller (*Physical Rev.*, 1940, [ii], 58, 805—811; cf. A., 1940, I, 433).—A new class of effects, called morphic effects, arising when elastic strains alter the symmetry of crystal structure, is considered. New coeffs., α acting strains, introduced into the matrix of the coeffs. characterising the linear effects, give rise to a series of new quadratic effects in crystal physics. The

morphic effects are especially large in Rochelle salt crystals, where they are responsible for the so-called Kerr effect and a new type of irreversible piezoelectric effects which has been verified. The new effect creates irreversible normal strains when the crystal is polarised in the a direction, and spontaneous contractions occur on cooling below the Curie point. The normal strains are responsible for the anomalous thermal expansion and other anomalies, and also, it is suggested, for the existence of the lower Curie point. N. M. B.

Nature of the anomalies of some properties of Rochelle salt and relation to the polymorphism. R. D. Shulvas-Sorokina (*J. Physics, U.S.S.R.*, 1939, 1, 299—307).—The part played by the piezo-effect in determining the electro-optical and optical properties of, and the pyro-effect in, Rochelle salt (I) is discussed. The Kerr effect can be regarded as having its origin in the piezo-effect, and on this assumption it is possible to explain experimental data on the Kerr effect without recourse to the hypothesis of regions of spontaneous orientation. Crystals of (I) are composed of dipoles which are free to rotate. The effect of temp. on the electro-optical properties of the compound is discussed. The electro-optical effect is a max. at the Curie point. A. J. M.

Tribo-electricity in wool and hair. A. J. P. Martin (*Proc. Physical Soc.*, 1941, 53, 186—189).—When wool fibres (or hairs) are rubbed together, the sign of the tribo-electric charges produced depends on the sense of the rubbing. This effect is due to the cuticle cells of the fibre, which are piezo- and pyro-electric. Pyro-electricity is absent or weak in the cortical cells. N. M. B.

Reversal of rectification by heat in crystal contacts and its analogy to a thermoelectric phenomenon. M. A. El Sherbini and Y. L. Yousef (*Proc. Physical Soc.*, 1941, 53, 120—125).—Using an air-thermostat, experiments on bornite show reversal below 200° for voltages < 1 v. There is evidence of a thermoelectric origin for the rectifying action. N. M. B.

Magnetisation of matter by light. F. Ehrenhaft and L. Banet (*Nature*, 1941, 147, 297; cf. A., 1940, I, 425; 1941, I, 93).—Magnetic poles are induced in non-magnetic and annealed pieces of Fe, placed perpendicularly to the geomagnetic field, by irradiation with ultra-violet light. The poles were mainly north magnetic, and persisted for several days. After short periods of irradiation the effect is local and on the surface; after long periods, saturation vals. are obtained. The characteristic of an induction coil with a Fe core is changed by ultra-violet irradiation. L. S. T.

Distribution of intensity of molecular diffusion of light in a crystal of non-uniform temperature. M. Leontovitch (*J. Physics, U.S.S.R.*, 1939, 1, 397—402).—The intensity distribution of the elastic waves of the Debye spectrum of a crystal is calc., and the expression obtained is applied to the determination of the intensity distribution of molecularly diffused light in an infinite cryst. lamina, the faces of which are at different temp. L. J. J.

Diffusion of light in a crystal of non-uniform temperature. G. Landsberg and A. Tschubin (*J. Physics, U.S.S.R.*, 1939, 1, 403—410).—The intensity-temp. relation for molecularly diffused light in a quartz crystal subjected to a temp. gradient of 80° per cm. differs from that in a uniformly heated crystal by $< 1\%$. The lower limit for the decay coeff. of amplitude for ultrasonic waves of frequency 2×10^{10} cycles per sec. is calc. as 0.75 cm^{-1} . L. J. J.

Conical refraction in naphthalene crystals. (Sir) C. V. Raman, V. S. Rajagopalan, and T. M. K. Nedungadi (*Nature*, 1941, 147, 268).—When suitably cut and mounted, crystals of C_{10}H_8 show the phenomena of conical refraction. Photographs are reproduced. Under conditions of perfect focus, the Poggendorf dark circle disappears. L. S. T.

Temperature-dependence of plastic deformation and creep. J. Frenkel (*J. Physics, U.S.S.R.*, 1940, 2, 49—54).—The Becker-Orowan theory of plastic slip (creep) velocity as a function of temp. is reviewed and an alternative theory, based on the assumption that the limit of elasticity of an ideal crystal lattice is zero, is advanced. A relaxation theory is given of creep, based on the assumption that the crystal lattice is distorted and accordingly hardened by previous slip and re-integrated by gradual return of the dislocated atoms to regular positions. The dynamics of the intermittent creep under small stresses on the basis of an analogy between

velocity-dependence of the limit of elasticity and that of the friction coeff. of two solid surfaces are outlined. W. R. A.

Influence of the temperature of crystallisation on the melting of crystalline rubber. N. Bekkedahl and L. A. Wood (*J. Chem. Physics*, 1941, 9, 193).—Dilatometric measurements indicate that the melting range of cryst. rubber rises with the temp. (θ) at which crystallisation occurred. For $\theta = 6-10^\circ$, fusion begins at $\sim 4^\circ$ above θ , and this interval increases as θ decreases. J. W. S.

Thermodynamical theory of the tensile strength of isotropic bodies. R. Fürth (*Proc. Roy. Soc.*, 1941, A, 177, 217—227).—The tensile strength of an isotropic body is expressed in terms of the elastic const. and the latent heat of fusion. Good agreement with experimental vals. is obtained.

G. D. P.
Theory of plastic deformation and twinning. J. Frenkel and T. Kontorova (*J. Physics, U.S.S.R.*, 1939, 1, 137—149).—Mathematical. The propagation of slip and twinning in crystals is treated as a wave-like motion. For a one-dimensional model, a chain of elastically linked atoms slipping over a fixed chain, two types of wave-like motion can occur: the propagation of small vibrations about equilibrium positions and a slip wave in which the atoms move from one position of equilibrium to another. The slip wave is propagated with a velocity approaching that of sound as its energy is increased and does not occur for energies $< a$ crit. val. W_0 . The damping effect due to the motion of the atoms underlying the movable chain is considered and the theory is generalised for the three-dimensional case. For a no. of metals those with high plasticity are found to have low vals. of W_0 .

O. D. S.
Polymorphism of C_{18} unsaturated fatty acids. G. B. Ravitsch, V. A. Volkova, and T. N. Kuzmina (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 88—90).—The existence of a modification of oleic acid with m.p. $19-20.5^\circ$ is established by heating and cooling curves. This modification is obtained after the acid has been kept at $7-9^\circ$ for several days.

F. L. U.

IV.—PHYSICAL PROPERTIES OF PURE SUBSTANCES.

Conductivity measurements on potassium halides. C. G. Brennecke (*J. Appl. Physics*, 1940, 2, 202—207).—The electrical conductivity κ of flat crystal plates of KBr and KCl has been measured at temp. from 25° to 600° , and potential gradients of 0.05 to 0.90 kv. per cm. κ at temp. $< 50^\circ$ is reduced by 15—25% after the first heating but then remains const. and unchanged by further heating. Ohm's law is obeyed. At low temp. the current I decays with time t according to $I = kt^{-m}$ where k and m are const. At high temp. I is const. for all vals. of t . For KBr κ varies with temp. T according to $= Ae^{-B/T}$, where A and B are const. The derived activation energy is 24.5 ± 0.5 kg.-cal. per mol. For KCl the same law is obeyed but the vals. of the const. A and B change sharply at a transition point at $\sim 200^\circ$. The activation energy for the region above the transition point is 45.8 ± 0.2 kg.-cal. per mol. O. D. S.

Absorption of ultrasonic waves in air and in monatomic gases. E. J. Pumper (*J. Physics, U.S.S.R.*, 1939, 1, 411—430).—Measurements of the absorption coeff. (α) of air, A, and He at 0.1—1 atm. pressure, for ultrasonic waves of 379—951.6 kilocycles per sec., are described. Non-uniformity of the ultra-acoustic field causes large deviations from the theoretical relation $\alpha \lambda^2 p = \text{const.}$ It is shown how such non-uniformities can be allowed for. For the above gases, at atm. pressure, $\alpha \lambda^2 = 0.00026$, 0.00022 , and 0.00066 , respectively. Existing data of earlier workers are critically reviewed. L. J. J.

Absorption of sound in solids. A. Achieser (*J. Physics, U.S.S.R.*, 1939, 1, 277—287).—The absorption of sound in dielectrics is considered theoretically. The absorption coeff. is independent of temp. if the latter is high, but at low temp. it is inversely \propto temp. The absorption coeff. is \propto square of frequency in both cases. The effect of thermal conductivity on absorption of sound has also been investigated.

A. J. M.
Absorption of sound in metals. A. Achieser (*J. Physics, U.S.S.R.*, 1939, 1, 289—298).—Theoretical. The absorption coeff. of sound in metals is shown to be \propto temp. (T) at high temp., and $\propto T^{-3}$ at low temp. A. J. M.

Velocity of sound in quartz. K. Vulfson (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 792—793).—The velocity of sound in quartz varies considerably with direction, and vals. are given for various directions. The results confirm the hypothesis of Gross that the complex structure of Rayleigh lines is due to the presence of three different acoustic oscillations in an anisotropic crystal. A. J. M.

Sound velocity in liquid mixtures. M. R. Rao (*Current Sci.*, 1940, 9, 534).—The product of v , the velocity of sound in liquids, and V , the mol. vol., viz., $v^{1/3}V = R$ (A., 1940, I, 104), gives R as a const. independent of temp. R is an additive function of chemical composition. Hence, in a mixture $R_{12} = M_{12}v_{12}^{1/3}/\rho_{12}$ (1) where M_{12} is the mean mol. wt. and v_{12} and ρ_{12} are the measured velocity and density, respectively. Also $R_{12} = xR_1 + (1-x)R_2$ (2), where x is the mol. fraction of one constituent. Agreement between (1) and (2) is very close. A test of both equations is applied to mixtures of BuOH and C_7H_{16} . W. R. A.

Specific heats of copper nitride, niobium nitride, and sodium azide, and the atomic heat of nitrogen. S. Satoh and T. Sogabe (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, 38, 174—182).—The sp. heats of Cu_3N ($0-99.6^\circ$), NbN ($0-300^\circ$), and NaN_3 ($0-99.6^\circ$) have been determined and the at. heat of N has been deduced from the mol. heats of these compounds by subtracting the at. heats of the metals.

W. R. A.

Latent heats of fusion of some organic refrigerants. J. H. Awbery (*Phil. Mag.*, 1941, [vii], 31, 247—253).—The latent heats of fusion of MeCl, EtCl, and CCl_2F_2 are 31, 17, and 8.2 g.-cal. per g., respectively. These vals. are not simply connected with the η or m.p. of the compounds. A. J. M.

Entropy of formic acid. Heat capacity from 15° to 300° K. Heats of fusion and vaporisation. J. W. Stout and L. H. Fisher (*J. Chem. Physics*, 1941, 9, 163—168).—The heat capacity of solid and liquid HCO_2H has been measured at $15-300^\circ$ K. The m.p. is 8.30° (281.40° K.) and the heat of fusion is 3031 g.-cal. per g.-mol. At 298.10° K. the v.p. is 4.31 cm. and the latent heat of vaporisation 4754 g.-cal. per g.-mol. Addition of an entropy val. of $0.5R \log_2 2$, due to random orientation of the H-bonds in the solid (Pauling, A., 1936, 275), to the vals. calc. from calorimetric measurements yields vals. of 31.51 and 47.46 entropy units per g.-mol. for the entropy of the liquid and saturated vapour, respectively, at 298.10° K. J. W. S.

Mathematics and science. G. N. Copley (*Chem. and Ind.*, 1941, 212—213).—A discussion of the significance of mathematical and physical equations in general, mainly in justification of the author's use of van der Waals' equation (cf. A., 1941, I, 78; Evans, *ibid.*, 106). A. J. E. W.

Equations of state. J. A. Beattie and W. H. Stockmayer (*Physical Soc. Rep. Progr. Physics*, 1940, 7, 195—229).—A progress report. W. J.

Gas imperfection. II. Thermodynamic quantities for some unsaturated aliphatic hydrocarbons derived from the equations of state. E. E. Roper (*J. Physical Chem.*, 1941, 45, 321—328).—Theoretical. With the aid of previously developed temp. coeff. equations for the second virials of seven unsaturated aliphatic hydrocarbons (A., 1941, I, 35), the second virials (θ), actual mol. vol. (V), temp. coeff. of V , and $C_p - C_v$ have been calc. for the standard state of 1 atm. and 25° . From v.p. equations and low-pressure data θ , V , fugacities, actual heats and entropies of vaporisation, and gas-imperfection corrections to the heats of vaporisation and abs. entropies have been calc. for the same compounds at their respective b.p. In general, the vals. of all these quantities increase as the mol. structure becomes more complex. The correlation of gas imperfection effects with chain length and g.-mol. wt. is discussed. Imperfection increases somewhat regularly with increase in chain length for a homologous series, but other properties, e.g., dipole moment, polarisability, etc., have considerable influence on the magnitude of the imperfection. C. R. H.

Dissociation treatment of condensing systems. IV. C. Ch'eng, T. P. Tseng, S. K. Feng, and W. Band (*J. Chem. Physics*, 1941, 9, 123—128).—The more exact theory (A., 1940, I, 18) is applied to 18 gases and the interaction energies per mol. in clusters formed during condensation of the saturated vapours are calc. as functions of temp. From the differences between the surface energy and observed surface

tension the nos. of heavy clusters in the saturated vapour over the liquid are calc. as functions of temp. For 8 vapours the theory predicts appreciable differences between the two crit. temp., that at which the meniscus becomes blurred (T_b) and that at which the densities of the two phases are equal (T_g). The largest differences are for H_2O (6.5°), $MeOH$ (5.1°), and NH_3 (4.1°). The true crit. vols. at T_g are calc. J. W. S.

Activity coefficients of gases. Calculation from the Beattie-Bridgeman equation of state. S. H. Maron and D. Turnbull (*Ind. Eng. Chem.*, 1941, 33, 69—72).—The Beattie-Bridgeman equation is employed to derive a relation expressing the activity coeffs. (γ) of gases as functions of pressure and temp. This is applied to the calculation of γ for N_2 , H_2 , and NH_3 , the results showing satisfactory agreement with experiment over wide pressure and temp. ranges. The relation can also be used to calculate the equilibrium activity coeff. ratio for the system $NH_3-N_2-H_2$. J. W. S.

Generalised equation for activity coefficients of gases. S. H. Maron and D. Turnbull (*Ind. Eng. Chem.*, 1941, 33, 246—248).—The activity coeff. of a gas (γ) is shown to be a function of the reduced temp. (T_r) and pressure (P_r) only. The equation $\log \gamma = 0.06477/T_r - 0.1706/T_r^2 - 0.04334/T_r^3 P_r + (0.002715/T_r^2 + 0.005165/T_r^3 - 0.0003231/T_r^5)P_r^2 - (0.00002669/T_r^6)P_r^3$ gives vals. of γ which agree with vals. read from Newton's generalised curves (cf. A., 1935, 575) for cases where T_r is < 1.3 and $P_r > 12$. At lower vals. of T_r , the agreement is good only when P_r is low. C. R. H.

Second law of thermodynamics and irreversible processes. P. W. Bridgman (*Physical Rev.*, 1940, [ii], 58, 845).—A discussion of Eckart's (cf. A., 1940, I, 406) equations for the evaluation of entropy increase when an irreversible process occurs within an isolated system. N. M. B.

Temperature-dependence of adiabatic compressibility. M. R. Rao (*Nature*, 1941, 147, 268—269).—The relation $k(\theta_c - \theta) = \sqrt{(V^{1/3}/M\beta_\theta)}$, where k is a const. characteristic of the liquid, θ_c is the crit. temp., V is the molar vol., and β_θ is the adiabatic compressibility, holds for C_6H_6 , CCl_4 , Et_2O , $PhCl$, $PhMe$, and $AcOH$, but not alcohols. L. S. T.

Structural viscosity in liquids and the derivation of equations for the flux of such liquids through tubes. F. Breazeale (*J. Appl. Physics*, 1940, 2, 187—192).—For the flux through a tube of a liquid showing no yield val., but possessing structural viscosity, an expression is derived on the hypothesis that above a certain crit. stress the effect of shear on viscosity is not immediately reversible, i.e., that a phenomenon analogous to thixotropy arises. The derived curves agree well in the Bingham region of the flux-pressure with experimental data for a cellulose "solution." O. D. S.

Viscosities of three classes of liquids. G. N. Copley (*Nature*, 1941, 147, 207—208).—An approx. linear relationship holds between the vals. of the consts. A and B in the equation $\eta = Ae^{B/RT}$. Ionic, OH^- , and non-polar liquids have representative points close to three separate straight lines which appear to have a common origin on the $\log A-B$ graph; and $B \sim m(1.65 - \log A)$, where m is a different const. for each of the three classes of liquid. Metallic liquids do not follow this equation. L. S. T.

Relation of fluidity to volume in organic liquids. E. C. Bingham and P. W. Kinney (*J. Appl. Physics*, 1940, 2, 192—202).—The Batschinski relation (cf. A., 1913, ii, 928) between the fluidity ϕ and mol. vol. V of a liquid is modified to the form $V = A\phi - B/\phi + C$, where A , B , and C are consts. The equation is applicable to all liquids whether associated or non-associated. The physical meaning of A , B , and C is discussed. O. D. S.

"Dry friction" forces. S. Chaikin, L. Lissovski, and A. Solomonovitch (*J. Physics, U.S.S.R.*, 1939, 1, 455—464).—A dynamic method of measuring tangential and normal forces between surfaces in contact at very small displacements is described. The method depends on the change in shape of the resonance curve of a quartz oscillator produced by contact with another body. At displacements insufficient to cause sliding, Hooke's law is obeyed for displacements up to $\sim 10^{-7}$ — 10^{-8} cm. At greater displacements the force between the surfaces increases more slowly than the displacement. Increase in the pressure between the surfaces increases the deviation from linearity. The limiting angle of friction decreases in the amplitude range where deviation from

Hooke's law is already marked. The deviations occur at comparable displacements and pressures for both normal and tangential displacements. L. J. J.

V.—SOLUTIONS AND MIXTURES (INCLUDING COLLOIDS).

Apparent and partial molal heat capacities and volumes of glycine and glycollamide. II. Concentrated solutions of glycollamide. F. T. Gucker, jun., and W. L. Ford (*J. Physical Chem.*, 1941, 45, 309—313).—The ρ and sp. heat tables for aq. solutions of $OH\cdot CH_2\cdot CO\cdot NH_2$ previously published (cf. A., 1939, I, 133) have been extended as a result of determinations with solutions ~ 6 -1M. C. R. H.

Dissolution and diffusion rates in alcohol-water mixtures. E. J. Roehl, C. V. King, and S. Kipness (*J. Amer. Chem. Soc.*, 1941, 62, 284—287).—Dissolution rates of Mg and Zn in HCl at 25°, and of Mg in $AcOH$ at 15°, 25°, and 35°, and diffusion coeffs. of HCl , $AcOH$, and KCl at 25° in $EtOH-H_2O$ mixtures have been measured. For HCl the dissolution rate and diffusion coeff. curves initially follow the fluidity curve but at 35% $EtOH$ show marked divergence from the fluidity curve; for $AcOH$ the curves are initially parallel but at 40% $EtOH$ the diffusion curve shows a marked divergence. The mechanism of the dissolution is discussed and it is concluded that the dissolution rate in HCl is controlled almost entirely by a normal diffusion process but in $AcOH$ the rate is partly, if not entirely, controlled by some other than the normal diffusion process. W. R. A.

Diffusion of water into *n*-butyl alcohol at 30°. M. Randall, B. Longtin, and H. Weber (*J. Physical Chem.*, 1941, 45, 343—351).—A refractometric investigation of the continuous diffusion of H_2O into Bu^oOH supports the view that the driving force in diffusion is the free-energy gradient rather than the concn. gradient. C. R. H.

Differential diffusion constant of calcium chloride in aqueous solution. E. A. Hollingshead and A. R. Gordon (*J. Chem. Physics*, 1941, 9, 152—153).—Using the method described previously (A., 1939, I, 192), the differential diffusion const. (k) of $CaCl_2$ has been determined for concns. of 0.0025—0.5M. at 15—35°. The simple relation between the val. of k at finite concn. and its val. at infinite dilution (A., 1937, I, 459) holds only to 0.01M. For 0.0025M. solutions the mean activation energies for the temp. differences 15—25° and 25—35° are 4.72 and 4.37 kg.-cal., respectively. With increasing concn. the val. falls until at 0.04M. it becomes almost independent of concn. and = 4.4 and 4.2 kg.-cal. for these temp. differences, respectively. J. W. S.

(A) Diffusion of chromic acid[s] in aqueous solution. (B) Diffusion of sodium and potassium chromate and dichromate. L. W. Ohlholm (*Finska Kem. Medd.*, 1940, 49, 9—13, 14—17).— D and η of 0.025—4.0M- CrO_3 and D of Na and K chromate and dichromate (0.1—4.0N.) solutions at 20° have been measured. At high dilution D falls rapidly with increasing concn. and then increases (CrO_3 and $Na_2Cr_2O_7$) or falls more slowly (other salts). D is always higher for the K than for the corresponding Na salt. The results are explained on the basis of dissociation of H_2CrO_4 at low and formation of poly-acids at high concns. M. H. M. A.

Change of index of refraction with concentration in solutions of water and *n*-butyl alcohol at 30°. B. Longtin, M. Randall, and H. Weber (*J. Physical Chem.*, 1941, 45, 340—343).—Data for the H_2O -rich and Bu^oOH -rich phases of the system Bu^oOH-H_2O are recorded. C. R. H.

Refractive index of electrolytic solutions at low concentrations. R. S. Narayan and B. R. Kulkarni (*J. Osmania Univ.*, 1940, 8, 25—36).—In sufficiently dil. solutions of $SrCl_2$ and $BaCl_2$, n is a linear function of concn. At higher concn. it becomes a linear function of (concn.)^{1/2}. F. J. G.

Molecular extinction coefficients of dissolved iodine in the photographic infra-red region. T. S. Hsiung (*Sci. Rep. Tsing Hua Univ.*, 1940, 4, 243—247).—Mol. extinction coeffs. at 4000—10,000 Å. are recorded in curves and tables for solutions of I in $MeOH$, $EtOH$, C_6H_6 , and CCl_4 . F. J. G.

Absorption of ultrasonic waves by electrolytes. P. A. Bashulin (*J. Physics, U.S.S.R.*, 1939, 1, 431—437).—Absorption measurements are recorded for ultrasonic waves of

4200—37,120 kilocycles per sec. in H_2O solutions of $Zn(OAc)_2$ (0.05—0.15 g.-mol. per l.), $La(NO_3)_3$ (0.1—0.25 g.-mol. per l.), and $Al_2(SO_4)_3$ (0.1 g.-mol. per l.), and in $EtOH$ solutions (0.1 g.-mol. per l.) of $Zn(OAc)_2$ and $La(NO_3)_3$. In all cases deviations from the theoretical quadratic absorption coeff.-frequency relation and from the linear absorption coeff.-concn. relation are found. L. J. J.

Refractive index of silicate glasses as a function of composition. M. L. Huggins (*J. Opt. Soc. Amer.*, 1940, **30**, 495—504; cf. A., 1940, I, 407).— R_D , the refraction of a glass per g.-atom of O, as defined by the Gladstone-Dale or Newton formulae, is $= \sum \alpha_M N_M$; α_M is a const. characteristic of each constituent element (other than O), and N_M is the no. of atoms of that element per atom of O. This expression has been verified for a wide range of silicate glasses, for which α_M vals. applicable to both types of refraction formula are derived. With glasses containing much Pb the calc. R_D vals. are too low. Tetrahedrally- and triangularly-surrounded B atoms require different α_M vals. Since the required d vals. can also be calc. (cf. A., 1941, I, 49) n_D for a given glass can be calc. directly from its composition. A. J. E. W.

Glass melts in the systems zirconia-alumina-silica and titania-alumina-silica. A. E. Badger and L. M. Doney (*Glass Ind.*, 1940, **21**, 309—311, 332).—The chemically pure materials with 3% of B_2O_3 were heated for 1 hr. at 1680° in zircon crucibles. Fusions were also made in the O_2-H_2 flame at >2000°. The clear glass, vitrified and sintered material areas of the fields are shown in triangular diagrams. Thermal expansion measurements made on fibres (apparatus described) give vals. for the ZrO_2 melts of $\sim 2 \times 10^{-6}$ and TiO_2 melts $\sim 4 \times 10^{-6}$. The ZrO_2 and TiO_2 glasses had n as high as 1.625 and 1.650, respectively. J. A. S.

Bethe-Kirkwood partition function for a binary solid solution. T. S. Chang (*J. Chem. Physics*, 1941, **9**, 169—174).—Mathematical. A symmetrical method of determining the Thiele semi-invariants λ_m in the partition function for a binary solid solution is described. λ_3 and λ_6 are calc. J. W. S.

Second-neighbour interactions and the critical behaviour of binary solid solutions. T. S. Chang (*J. Chem. Physics*, 1941, **9**, 174—176).—Mathematical. The Thiele semi-variants, γ_1 , γ_2 , and γ_3 of a binary solid solution are calc. on the assumption that there are second-neighbour, as well as first-neighbour, interactions. The results give a decrease of the crit. temp. (T_c) at which the superlattice sets in, an increase of the local order at T_c , and an increase of the discontinuity of the sp. heat, in general accord with the results obtained by applying Bethe's method. J. W. S.

Equilibrium solidification of solid solutions. M. Cohen and W. P. Kimball (*Amer. Inst. Min. Met. Eng.*, 1940, *Tech. Publ.* 1256, 2 pp.; *Met. Tech.*, **7**, No. 8).—The composition, δ , of the infinitesimal trace of alloy which transfers from the liquid to the solid state at each temp. during the equilibrium solidification of a binary solid solution $= [Z_L x_L (x_L - P) + Z_S x_S (P - x_S)] / [Z_L (x_L - P) + Z_S (P - x_S)]$, where Z_L and Z_S are the slopes of the liquidus and solidus lines, x_L and x_S are the compositions of liquid and solid stable phases at the given temp., and P is the composition of the alloy under consideration. Calc. δ curves are given for the solidification of five sp. alloys in the Fe-C system. J. C. C.

Gamma phase of lithium-lead alloys, $Li_{10}Pb_3$; stoichiometry and structure. M. A. Rollier and E. Arregghini (*Z. Krist.*, 1939, **101**, 470—482).— $Li_{10}Pb_3$, prepared by fusing 44 parts of Pb with 6 parts of Li in an atm. of A, is cubic with a 10.082 Å. (from powder X-radiograms); ρ 4.42; 4 mols. in unit cell; space-group T_d . The structure, which is confirmed by calc. intensities, is similar to that of γ -brass, and corresponds with the at. arrangement in Cu_3Al_4 (Bradley and Jones, A., 1933, 454). The valency and Hume-Rothery rules are not obeyed in binary Li alloys. A. J. E. W.

Equilibrium diagram of the system silver-zinc. K. W. Andrews, H. E. Davies, W. Hume-Rothery, and C. R. Oswin (*Proc. Roy. Soc.*, 1941, A, **177**, 149—167).—The diagram was investigated by thermal, microscopic, and X-ray methods. The depression of m.p. of Ag by Zn is slightly > that produced by equal at.-% of In. At 50 at.-% of Zn the solidus and liquidus do not coincide; the alloy freezes over a range of $\sim 3.5^\circ$. The determination of phase boundaries by X-rays

is found to be unreliable and the limitations of the method are discussed. G. D. P.

X-Ray study of the solid solubility of lead, bismuth, and gold in magnesium. F. Foote and E. R. Jette (*Amer. Inst. Min. Met. Eng.*, 1940, *Tech. Publ.* 1248, 8 pp.; *Met. Tech.*, **7**, No. 8).—Comparison between the vals. of d measured on annealed filings and those calc. from the lattice consts. indicates that the Pb-Mg and Bi-Mg solid solutions are of the simple substitutional type. The solid-solubility curves have been determined. The solubility of Pb in Mg falls from 39.6% at 468° to 1.8% at 100°, and of Bi from 9.05% at 553° to 0.10% at 250°. The solid solubility of Au has been checked by an indirect method and found to be <0.1 at.-% at 560°.

J. C. C.
Pre-precipitation phenomena in age-hardening alloys. F. W. Jones and P. Leech (*Nature*, 1941, **147**, 327—328).—The sp. heat-temp. curve (reproduced) of an Al-Ag alloy (40% Ag) quenched from 550° and aged for 7 days at room temp. resembles those found with Al-Cu and may be interpreted similarly. L. S. T.

Concentrated ferromagnetic amalgams. L. F. Bates (*Proc. Physical Soc.*, 1941, **53**, 113—115; cf. A., 1940, I, 351).—Attempts to obtain conc. fluid Ni amalgams are described. An amalgam of 0.091 at.-% of Ni, formed at several temp. below 225°, becomes fluid at lower temp. Conc. amalgams formed by low-temp. distillation become ferromagnetic above 225° at Ni 25 at.-%. N. M. B.

Structure of intermetallic phases in the system tungsten-cobalt and molybdenum-cobalt. III. M. M. Babitsch, E. N. Kisiljakova, and J. S. Umanski (*J. Physics, U.S.S.R.*, 1939, **1**, 309—313).—In the W-Co system, the compound to which the formula WCo was formerly assigned has been proved to be W_3Co_7 . It crystallises in the rhombohedral system, with 13 atoms in the unit cell; a 8.98 Å., α 31° 19'; space-group $D_{3d}^5-R_{3m}$. In the Mo-Co system, the compound formerly regarded as $MoCo$ has been proved to be Mo_6Co_4 . It crystallises in the rhombohedral system; a 8.99 Å., α 31° 16'; space-group as above. A. J. M.

Metallography and certain physical properties of some alloys of cobalt, iron, and titanium. C. R. Austin and C. H. Samans (*Amer. Inst. Min. Met. Eng.*, 1940, *Tech. Publ.* 1257, 11 pp.; *Met. Tech.*, **7**, No. 8).—The quasi-binary equilibrium diagram of the system Co-Fe₂Ti was determined in part by metallographic examination of three alloys quenched from various temp. The solid solubility of Fe₂Ti in the α solid solution varies from $\sim 3\%$ at 500° to $\sim 25\%$ at the eutectic temp. of 1200°. Alloys with ~ 4 , 12, and 16% of Fe₂Ti respectively (with 1.5—2.25% of Fe) showed pptn.-hardening when quenched from 950—1300° and subsequently aged at 600—900°. The richer alloys appeared to show strain-hardening effects at 600° and 700°. Creep curves were determined at 600°, 700°, and 800°, using loads of 2000—10,000 lb. per sq. in.; the results suggest that, at 700° and 800°, stress may accelerate the pptn. reactions. J. C. C.

Solubility of acetylene in blood.—See A., 1941, III, 168.

Solubilities of cupric selenates from 0° to 40°. C. H. Kao and T. L. Chang (*Sci. Rep. Tsing Hua Univ.*, 1940, **4**, 155—158).—Solubility data at 0—40°, and ρ for the saturated solution at 15—25°, are recorded for $CuSeO_4 \cdot 5H_2O$. Above 40° some hydrolysis, with separation of a basic salt, occurs, but the solid phase in equilibrium with the solution is $CuSeO_4 \cdot 5H_2O$ up to 80°. F. J. G.

Samarium selenate and its solubility in water. J. N. Friend (*J.C.S.*, 1941, 112—113).—Solubility data for $Sm_2(SeO_4)_3$ at 17—80° are given. The stable solid phase over this range is $Sm_2(SeO_4)_3 \cdot 8H_2O$, and this is stable in dry air. The solubility decreases with rise of temp. Separation of Sm and Nd by crystallisation of the selenates is not practicable. F. J. G.

Solubility product and the solubility of metal sulphides in water. A. F. Kapustinski (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, **28**, 144—147).—The following vals. of solubility products have been calc. from the free energies of formation of the compounds: Bi_2S_3 7.1×10^{-61} , Sb_2S_3 2.9×10^{-59} , Ag_2S 5.9×10^{-52} , Cu_2S 2.6×10^{-49} , CuS 3.2×10^{-38} , PbS 6.8×10^{-29} , CdS 1.2×10^{-28} , SnS 1.0×10^{-27} , ZnS 7.4×10^{-27} , CoS 3.1×10^{-23} , FeS 3.8×10^{-23} , MnS 1.1×10^{-15} , MgS 2.0×10^{-15} . The solubilities of the sulphides at p_H from 3 to 11

have been calc. from their solubility products by the method of Verhoogen (A., 1938, I, 306). O. D. S.

Solubility and titration of hæmin and ferrihæmic acid. D. B. Morrison and E. F. Williams, jun. (*J. Biol. Chem.*, 1941, **137**, 461—473).—Ferrihæmic acid requires 2 equivs. of base and hæmin 3 for conversion into a sol. dibasic salt. Absence of a break in titration and solubility curves shows that the two CO_2H groups are approx. equally ionised and dibasic (not monobasic) salts are formed. The overall charge of the ferrihæmate ion is negative. The solubility of ferrihæmic acid is 0.001 g. per l. and of hæmin 0.0009 g. per l.

E. M. W.

Base exchange of the clay mineral montmorillonite for organic cations and its dependence on adsorption due to van der Waals forces. S. B. Hendricks (*J. Physical Chem.*, 1941, **45**, 65—81).—The interplanar spacings of numerous org. salts of clay mineral montmorillonite which have been measured show that the org. cation is held to the surface of the silicate layers by interionic Coulomb forces and by van der Waals attraction of the mols. to the surface. The amount of interplanar spacing depends on the structure of the org. cation and on the way it is adsorbed on the silicate surface. The determination of this spacing (van der Waals "thickness") enables the structure of mols. to be determined. Fluorene, adenine, and guanine are shown to be planar mols., whilst in guanosine and adenosine the plane of the ribofuranose ring is parallel to that of the guanine or adenine mol. respectively.

C. R. H.

Lyotropic series. III. Adsorption of salts on cellulose. E. Heymann and G. C. McKillop (*J. Physical Chem.*, 1941, **45**, 195—203).—The adsorption of alkali salts by cotton wool decreases in the order $\text{CNS}' > \text{I}' > \text{IO}_3' > \text{Br}' > \text{NO}_3' > \text{Cl}' > \text{tartrate} > \text{OAc}' > \text{SO}_4'$. Alkaline-earth salts are only slightly adsorbed, the order being $\text{Ba}'' > \text{Ca}'' > \text{Sr}'' > \text{Mg}''$. The adsorption of CuCl_2 and CuSO_4 dissolved in NH_3 supports the view that combination takes place between cellulose and Cu-NH_3 complex. The data show that there is a close connexion between the order of adsorption and the usual lyotropic series. For the anions and bivalent cations adsorption is determined mainly by affinity for H_2O , ions with a high energy of hydration being weakly adsorbed. Univalent cations do not follow this rule, a sp. affinity between ion and cellulose outweighing the affinity between ion and H_2O .

C. R. H.

Structure of adsorption layers and form of surface tension isotherms. A. B. Taubman (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, **29**, 103—107).—Vals. of mol. const. of saturated adsorption layers, viz., the min. area per mol., the thickness of the layer, and their variations in homologous series have been determined for layers of different classes of substance on H_2O . The results show that s-dibasic acids, their Et esters, and glycols are oriented horizontally. $\text{C}_6\text{H}_5\text{N}$, all its Me and Me_2 homologues, and nicotine are also oriented horizontally, whilst piperidine and quinoline, in which the highly polar double bonds of $\text{C}_6\text{H}_5\text{N}$ are absent or offset by the less polar C_6H_4 ring, are oriented vertically. An explanation is offered for the inflexion in the surface tension depression-concn. curves observed with certain of the substances studied.

F. L. U.

Surface tension of solutions of electrolytes as a function of concentration. II. G. Jones and W. A. Ray (*J. Amer. Chem. Soc.*, 1941, **62**, 288—294; cf. A., 1937, I, 446).—The relative surface tensions (γ) of aq. solutions of BaCl_2 , SrCl_2 , KClO_3 , KCNS , $\text{K}_3\text{Fe}(\text{CN})_6$, $\text{K}_4\text{Fe}(\text{CN})_6$, CsI , and LiF have been measured at 25° over the concn. range 0—5*N*. at 25° . A decrease in γ at approx. 0.001*N*. was observed, which is in agreement with previous data for KCl , K_2SO_4 , and CsNO_3 , and suggests that all salts are "capillary-active" in sufficiently dil. solution. With increasing concn. γ increases, the salts becoming "capillary-inactive." The theoretical significance of the results is discussed and the validity of the Onsager-Samaras and Dole equations for the variation of γ with concn. is considered.

W. R. A.

Change with time of surface tension of sodium laurate solutions. G. C. Nutting and F. A. Long (*J. Amer. Chem. Soc.*, 1941, **62**, 84—88).—The decrease with time of γ of aq. solutions of Na laurate at 25° between 0.001*N*. and 0.07*N*. and at p_H 7—11 has been measured using the sessile bubble method. At p_H 11 and concns. < the crit. concn. for micelle formation γ decreases gradually for several hr., the equilibrium γ de-

pending on concn. In solutions of micellar concn. the time effect practically disappears. With decreasing p_H the equilibrium γ and time effect diminish markedly and this is probably due to closer packing of fatty acid mols. than of ions in the surface film and the more rapid diffusion of non-ionised mols. into the surface region.

W. R. A.

Demonstration of "wetter" water. C. R. Caryl (*J. Chem. Educ.*, 1940, **17**, 468).—The addition of a few drops of conc. Aerosol O.T. causes powdered S, string, cotton, or wool to sink immediately in H_2O .

L. S. T.

Motion of a mercury index in a capillary tube. M. A. Abbasi and S. M. Ali (*J. Osmania Univ.*, 1940, **8**, 37—60). F. J. G.

Measuring the effective areas of film-forming molecules. N. F. Miller (*J. Physical Chem.*, 1941, **45**, 289—299).—A rapid method for measuring the effective areas of polar mols. is based on the equilibrium of tensions established at the point where the pressure developed in the deposited monolayer has become large enough to prevent the spreading of a lens of solution on the substrate. When C_6H_6 solutions of polar substances ($0.5\text{—}2 \times 10^{-6}$ g.-mol. per c.c.) are deposited on a substrate, the first stable lens is formed when the substrate is covered with a monolayer at a film pressure of 10.3 ± 0.3 dynes per cm. Further addition of C_6H_6 solution develops higher film pressures accompanied by an increase in the lens angle. The technique of the method is fully dealt with and six criteria are given for distinguishing the equilibrium lens from lenses immediately preceding it. The theory of the method is discussed.

C. R. H.

True surface densities of protein films. A. Norris (*Nature*, 1941, **147**, 358).—Data for the spreading of zein and of hen ovalbumin on 0.01*N*- H_2SO_4 at room temp. are recorded, and discussed in relation to initial uneven spreading and to contamination of the films on keeping.

L. S. T.

"Surface elasticity" of protein films. II. Properties of partially and of completely spread films. J. B. Bateman and L. A. Chambers (*J. Physical Chem.*, 1941, **45**, 209—222).—Data previously obtained (cf. A., 1939, I, 316) for the spread of ovalbumin films on H_2O have been extended in order to study the variations of max. surface elasticity, M_m , over a wider range of vals. for the measured limiting area, A_0 . Variations of p_H of the substrate can produce a ten-fold variation in A_0 without much change in M_m . With increasing p_H , M_m decreases slightly whereas A_0 shows a pronounced max. at the isoelectric point. Much of the data can be explained if it be assumed that A_0 differs from the true limiting area A_0 . The ratio A_0/Λ_0 may vary widely for a given substrate. There is no way of determining A_0 and until this is possible the observed effect of p_H on M_m has limited theoretical val. The data are discussed with reference to theories of film structure.

C. R. H.

Compressed films at solid-liquid interfaces. J. L. Culbertson and L. L. Winter (*J. Amer. Chem. Soc.*, 1941, **62**, 95—97).—The unfrozen H_2O on wetted SiO_2 gel and C surfaces has been determined from 0° to -50° by the calorimeter method. Assuming the sp. areas of the solids to be comparable it was found that SiO_2 binds H_2O more strongly than does C.

W. R. A.

Properties of multimolecular layers of non-aqueous liquids. M. Kusakov and A. Titievskaja (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, **28**, 332—335).—Capillary pressure (P)-film thickness (h) isotherms have been obtained for films of *n*-paraffins between a bubble and a solid surface. For a given P , h is a max. for $\text{C}_8\text{—C}_{10}$. For different surfaces, h increases in the order quartz < diamond < Pb glass < steel. Addition of fatty acids increases h , but H_2O has no effect.

L. J. J.

Permeability of membranes. VI. Passage of an electric current across selective membranes. K. H. Meyer and W. Straus (*Helv. Chim. Acta*, 1940, **23**, 795—800; cf. A., 1937, I, 408).—When a current of 0.75 ma. is passed across a composite membrane consisting of 4 membranes permeable to cations and 3 permeable to anions (selectivity const. 0.02 and 0.017 respectively), arranged alternately and immersed in 0.01*N*- KCl , a polarisation e.m.f. of 100 mv. is obtained 20 sec. after interrupting the current. This e.m.f. decreases rapidly and approaches zero after 30 min.

F. L. U.

Dielectric properties of protein solutions. III. Lactoglobulin. J. D. Ferry and J. L. Oncley (*J. Amer. Chem. Soc.*, 1941, **63**, 272—278; cf. A., 1938, I, 357).—Dielectric const.

of solutions of lactoglobulin (I) in 0.25M- and 0.50M-glycine have been measured at 0° and 25° over a frequency range of 10^4 – 5×10^6 cycles per sec. and the dielectric increments per g. per l. have been determined. The dipole moment of (I) is 730 D. at 25° and 770 D. at 0°. Dispersion curves are compared with those from η , diffusion, and ultracentrifuge measurements. All data are interpretable by postulating an elongated, ellipsoidal mol., having $a/b = 4$ and 0.3 g. of H_2O of hydration per g. of (I). W. R. A.

Experiments on thixotropic and other anomalous fluids with a new rotation viscometer. J. Pryce-Jones (*J. Sci. Instr.*, 1941, 18, 39–48).—The viscometer consists, in principle, of two identical Couette viscometers rotating in opposite directions. Its use in the study of anomalous η , thixotropy, dilatancy, elastic recoil, yield val., and the degree of dispersion of suspensions of solids in liquids is described. The author criticises the rather loose meanings assigned by many writers to certain rheological terms and illustrates the true meanings of these terms. C. R. H.

Chlorophyll. III. Cataphoresis and electrolytic coagulation of colloidal chlorophyll. M. A. R. Khan and M. Qureshi (*J. Osmania Univ.*, 1940, 8, 1–5).—In chlorophyll hydrosols the particles are negatively charged. The concns. of KCl, $MgCl_2$, and $AlCl_3$, respectively, required for flocculation are as 2000 : 100 : 1. F. J. G.

VI.—KINETIC THEORY. THERMODYNAMICS.

Sorting of mixed solvents by ions. G. Scatchard (*J. Chem. Phys.*, 1941, 9, 34–41).—By application of the method of Debye and McLaughlin (A., 1925, ii, 171), the electrostatic interaction of ions with non-electrolytes is calc. for EtOH– H_2O mixtures, and an approx. relation, which can be extended to other solvents, is derived. Agreement with experiment is unsatisfactory, probably owing to neglect of the discrete structure of the solvent. J. W. S.

Fourth ionisation constant of ferrocyanide acid. O. E. Lanford and S. J. Kiehl (*J. Physical Chem.*, 1941, 45, 300–304).—Measurement of H^+ activity in solutions of $K_4Fe(CN)_6$ or $Na_4Fe(CN)_6$ and HCl gives the val. 6.8×10^{-5} for the fourth ionisation const. of $H_4Fe(CN)_6$. C. R. H.

Physico-chemical studies of the simpler polypeptides. I. Dissociation constants of glycine, mono-, di-, tri-, tetra-, penta-, and hexa-glycylglycine and their esters. S. Glasstone and E. F. Hammel, jun. (*J. Amer. Chem. Soc.*, 1941, 62, 243–248).—The dissociation consts. of glycine, mono-, di-, tri-, tetra (I), penta (II), and hexa-glycylglycine (III), of the Et ester hydrochlorides of the first four, and of the Me ester hydrochloride of (II) have been determined at 20° by potentiometric titration using the glass electrode. The results agree with the concept of a freely rotating chain of increasing length up to and including (I). The sudden increase in dissociation const. of $+NH_3^+R\cdot CO_2^-$ at (II) combined with the low dielectric increment (cf. A., 1933, 459) suggests that in (II) and (III) there is a restriction to free movement in the $+NH_3^+R\cdot CO_2^-$ form which does not exist in $NH_2\cdot R\cdot CO_2^-$. Measurements for $+NH_3^+R\cdot CO_2H$ indicate that in (II) and (III) it has the same structure as $+NH_3^+R\cdot CO_2^-$. W. R. A.

Graphical correlation between p_H values, molarities, and dissociation constants of weak acids. N. Porges and T. F. Clark (*J. Chem. Educ.*, 1940, 17, 571–573).—Curves for HCl, $H_2C_2O_4$, HCO_2H , AcOH, H_2CO_3 , H_3BO_3 , PhOH, $PrCO_2H$, fumaric, citric, gluconic, and lactic acids, and glucose are reproduced, and their applications discussed. L. S. T.

Acid strength of bile acids. W. D. Kumler and I. F. Halverstadt (*J. Biol. Chem.*, 1941, 137, 765–770).—The dissociation consts. for lithocholic, cholic, dehydrocholic, and other bile acids lie within the range $pK_a = 6.10$ – 6.20 in 50 vol.-% EtOH– H_2O and are almost identical with that for $n-C_{25}H_{51}\cdot CO_2H$. They are higher in pure H_2O . P. G. M.

Liquid ammonia as a solvent. IX. Activity coefficient of potassium iodate at 25°. V. J. Anhorn and H. Hunt (*J. Physical Chem.*, 1941, 45, 351–362).—The activity product of KIO_3 in liquid NH_3 at infinite dilution has been determined from solubility measurements in presence of KCl, KBr, KI, NaCl, and NH_4Cl . Deviations from the limiting Debye-Hückel theory are ascribed to the low dielectric const. for

liquid NH_3 , as a result of which the ions of the two electrolytes affect each other owing rather to the electrostatic forces between them than to the effect of their electric fields on the NH_3 mols. C. R. H.

Thermodynamic study of the system zinc sulphate-sulphuric acid-water at 25°. H. V. Tartar, W. W. Newshwander, and A. T. Ness (*J. Amer. Chem. Soc.*, 1941, 63, 28–36).—Thermodynamic activities (a) of H_2O , $ZnSO_4$, and H_2SO_4 have been determined independently at 25° in solutions varying from 0.1 to 4.0M. with respect to H_2SO_4 and 0.5 to 2.0M. with respect to $ZnSO_4$. For H_2O a was determined from v.p. measurements; for H_2SO_4 a was obtained from the e.m.f. of cells of the type $H_2|H_2SO_4(m_1)|ZnSO_4(m_2)|Hg_2SO_4|Hg$. The e.m.f. of cells of the type Zn–Hg (one phase) $|H_2SO_4(m_1)|ZnSO_4(m_2)|Hg_2SO_4|Hg$ were measured and from these vals. the e.m.f. of cells $Zn|H_2SO_4(m_1)|ZnSO_4(m_2)|Hg_2SO_4|Hg$ were calc. and from these calc. e.m.f. vals. a for $ZnSO_4$ was computed. The vals. for ΔG and ΔH for the reaction $ZnSO_4 + H_2O \rightarrow Zn + H_2SO_4 + \frac{1}{2}O_2$ have been calc. for a series of solutions. The energy efficiency of the electrolytic Zn process is discussed. An improved type of dynamic v.p. apparatus is described. W. R. A.

Osmotic and activity coefficients of trivalent chlorides in aqueous solution at 25°. C. M. Mason (*J. Amer. Chem. Soc.*, 1941, 63, 220–223).—Isotonic ratios and osmotic coeffs. have been determined at 25° for aq. $SmCl_3$ and $EuCl_3$. A new method, based on Debye's theory, of smoothing osmotic coeffs. is described. Activity coeffs. have been calc. by the new method for aq. $AlCl_3$, $ScCl_3$, YCl_3 , $LaCl_3$, $CeCl_3$, $PrCl_3$, $NaCl_3$, $SmCl_3$, and $EuCl_3$. W. R. A.

X-Ray diffraction studies in the system $CuO-Fe_2O_3$. W. O. Milligan and J. Holmes (*J. Amer. Chem. Soc.*, 1941, 63, 149–150).—From X-radiograms it is concluded (i) that mixtures of CuO and Fe_2O_3 , pptd. at 25° and air-dried, contain no Cu^{II} ferrite, $CuFe_2O_4$, (ii) that refluxing the samples with H_2O for 24 hr. at 100° induces no formation of $CuFe_2O_4$, and (iii) that heating to 1000° for 1 hr. followed by quenching in cold H_2O and air-drying yields cryst. $CuFe_2O_4$. These data agree completely with those of Holgersson (A., 1929, 1131) and of Wartmann and Thompson (A., 1935, 312) but are in contrast with the results of Forestier and Lonquet (A., 1939, I, 482). W. R. A.

Liquid-crystalline, waxy, and crystalline phases in binary mixtures of pure anhydrous soaps. M. J. Vold (*J. Amer. Chem. Soc.*, 1941, 62, 160–168).—The stable phases of a Na salt of a n -fatty acid that can occur between room temp. and melted liquid temp. are cryst. (of which there is more than one kind), subwaxy, waxy, superwaxy, subneat, neat, and ordinary liquid. For Na palmitate (I), using a hot-wire technique, five of these phases have been observed and transition temp. determined. Portions of phase-rule diagrams for anhyd. binary mixtures of (I) with Na stearate (II), laurate (III), and behenate (IV), and of (II) with (III) and Na oleate (V), have been determined and the identity of some of the equiv. forms of the different soaps established. The anhyd. neat soap form found in (II) is absent in (IV) and (V). The so-called superwaxy phase is recorded for the first time. W. R. A.

Stable phases occurring between true crystal and true liquid for single pure anhydrous soaps. M. J. Vold, M. Macomber, and R. D. Vold (*J. Amer. Chem. Soc.*, 1941, 62, 168–175; cf. preceding abstract).—Dilatometric and microscopic study has been made of transition temp. between successive stable forms of all members of the homologous series of Na salts of n -fatty acids containing an even no. of C atoms from C_6 to C_{22} , and of Na cerotate and oleate and K stearate (I). For the entire sequence of Na soaps examined behaviour similar to that of Na palmitate has been observed but the no. of intermediate forms is not the same for each soap. The regularity of the curves of transition temp. against chain length, and similarities in vol. change, visual and microscopic appearance, suggest a similar mol. arrangement in corresponding phases of C_{14} to C_{22} , and possibly of C_{12} . In two instances curves of transition temp. against chain length run together and give rise to a change in the no. of stable phases intervening between the normal cryst. and isotropic liquid forms. With (I) a similar but probably not identical sequence was found. Measurements using a hot-wire technique were in accord with dilatometric observations. The relationship between transition temp. and chain length is briefly discussed. W. R. A.

System nitromethane-*n*-propyl alcohol-water. Vapour-liquid equilibria in the ternary and the three binary systems. A. R. Fowler and H. Hunt (*Ind. Eng. Chem.*, 1941, 33, 90—95).—The system $\text{MeNO}_2\text{-Pr}^n\text{OH}$ has been investigated at 25°, analysis being carried out by *d* and *n* measurements on the liquid and condensed vapour phases. The solubility equilibria are shown in a graph, whilst the compositions of various binary and ternary mixtures and of the vapours in equilibrium with them are shown in graphs and tables. A ternary azeotrope with min. b.p. (82.3°) contains MeNO_2 55.9 and Pr^nOH 26.6%. This azeotrope could be used to separate MeNO_2 from a large vol. of H_2O and Pr^nOH . J. W. S.

System sodium bromide-hydrogen bromide-water. S. J. O'Brien, C. L. Kenny, and R. J. Fuxa (*J. Chem. Educ.*, 1940, 17, 576—577).—Apparatus and procedure for determining the phase diagram for this system are described. L. S. T.

25° isotherm of the systems $\text{CaO-B}_2\text{O}_3\text{-H}_2\text{O}$ and $\text{MgO-B}_2\text{O}_3\text{-H}_2\text{O}$. A. V. Nikolaev and A. G. Tschelischtscheva (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 127—130).—Compounds $\text{CaO} \cdot \text{B}_2\text{O}_3 \cdot 6\text{H}_2\text{O}$ (I), $2\text{CaO} \cdot 3\text{B}_2\text{O}_3 \cdot 13\text{H}_2\text{O}$ (II) (inoite), and $\text{CaO} \cdot 3\text{B}_2\text{O}_3 \cdot 4\text{H}_2\text{O}$ (III) are formed. Refractive indices are respectively: (I) n_D 1.512, n_p 1.504, crystals biaxial, negative, hexahedral prisms, and (III) n_D 1.550, n_p 1.505. *n* of (II) are equal to those of natural inoite. Compounds $2\text{MgO} \cdot 3\text{B}_2\text{O}_3 \cdot 15\text{H}_2\text{O}$ (IV) (inderite), the diborate $\text{MgO} \cdot 2\text{B}_2\text{O}_3 \cdot 9\text{H}_2\text{O}$ (V), and triborate $\text{MgO} \cdot 3\text{B}_2\text{O}_3 \cdot 7.5\text{H}_2\text{O}$ (VI) are formed. *n* of (IV) are equal to those of natural iinderite. For (V) n_m 1.485, n_p 1.442, crystals rounded, uniaxial, negative, hexagonal. For (VI) n_D 1.508, n_p 1.463, crystals uniaxial, negative. O. D. S.

Heats of organic reactions. X. Heats of bromination of cyclic olefines. M. W. Lister (*J. Amer. Chem. Soc.*, 1941, 63, 143—149).—Heats of bromination of olefines in CCl_4 by Br have been measured by a vac. calorimeter (described). V.p. of olefines and their dibromides have been measured over a range of temp. Hence heats of vaporisation and of bromination at 27° have been calc. and are, respectively: cyclopentene, 6780, 28,610; -hexene, 7789, 33,630; -heptene, 8779, 30,440; -octene, 9936, 29,310; Δ^a -heptene, 8587, 30,240; Δ^a -butene, —, 28,900 g.-cal. No satisfactory explanation of observed data can be advanced but the existence of repulsive forces between non-bonded adjacent atoms is favoured rather than attractive forces. W. R. A.

Calorimetric investigations of organic reactions. III. Heats of ionisation of glycine at 25°. J. M. Sturtevant (*J. Amer. Chem. Soc.*, 1941, 63, 88—93).—Heats of neutralisation of glycine by HCl and NaOH have been measured calorimetrically at 25° and from these the heats of ionisation, respectively 930 and 2771 g.-cal. per mol., have been calc. and are in good agreement with existing data. W. R. A.

Heat of mixing of chloroform with polyamines. R. W. Spence (*J. Physical Chem.*, 1941, 45, 304—309).—The max. vals. for the heat of mixing, *H*, of CHCl_3 with cyclohexylamine (I), NH_2Bu , $(\text{CH}_2)_2\text{NH}_2$, diethylenetriamine, and triethylenetetramine are 800, 700, 440, 640, and 800 g.-cal. per mol. of solution respectively. For the first two compounds *H* occurs at 0.5 mol. fraction of CHCl_3 , and for the remainder it occurs at 0.6 mol. fraction of CHCl_3 . The drop in *H* in going from (I) to the polyamines suggests that the latter are associated through $\text{N-H} \cdots \text{N}$ bonds. On mixing with CHCl_3 , energy is liberated when $\text{C-H} \cdots \text{N}$ bonds are formed and energy is used in breaking $\text{N-H} \cdots \text{N}$ bonds, the resulting *H* being < it would be if the polyamine was unassociated. It is not possible to decide from the position of the max. in the *H* curves how many N atoms in the polyamines are available for bonding. C. R. H.

Heat of wetting of wood charcoal by some common liquids. R. I. Razouk (*J. Physical Chem.*, 1941, 45, 179—189).—An ampoule containing charcoal was evacuated at 300° for 6 hr. and then sealed. It was then broken under various liquids and the heat change resulting from the wetting of the C was measured. H_2O , aliphatic alcohols, C_6H_6 , $\text{C}_2\text{H}_5\text{N}$, and CCl_4 were investigated. With H_2O and MeOH the heat of wetting (*H*) is developed within a few min., but with other liquids the time is appreciable and increases in the order EtOH , Pr^nOH , Bu^nOH , Pr^nOH , $\text{C}_2\text{H}_5\text{N}$, reaching ~30 min. in the case of C_6H_6 . *H* depends not only on the surface area of the C but on its nature and the manner in which it has been treated. The data afford strong support for the explanation of *H* in

terms of free energy changes at the C surface and their temp. coeffs. as measured by the expansion of C on immersion in the liquids. C. R. H.

Heat of wetting of partially saturated charcoal. R. I. Razouk (*J. Physical Chem.*, 1941, 45, 190—194; cf. preceding abstract).—The heat developed when charcoal containing known amounts of MeOH is immersed in MeOH has been measured. The differential heat of wetting is const. and equals the calc. net heat of adsorption for the later stages of adsorption. If the C is initially saturated with MeOH no measurable heat is evolved on immersion in MeOH . This is unexpected but it is possible that the slow rate at which heat is evolved renders its detection and measurement difficult. C. R. H.

VII.—ELECTROCHEMISTRY.

Conductivity of calcium salts. A. S. Jensen and M. R. Unangst (*J. Chem. Physics*, 1941, 9, 195).—The conductivities of 0.1, 0.01, and 0.001*N*. solutions of Ca gluconate (I), benzoate, lactate, laevulate, and salicylate, CaCl_2 , and CaBr_2 at 18° are given. Additional data for solutions of (I) at 18° and 25° are also recorded. J. W. S.

Flow potentials through metals. W. G. Eversole and D. L. Deardorff (*J. Physical Chem.*, 1941, 45, 236—241).—Theoretical. A general equation permitting the calculation of the p.d. set up by liquid flow through a small hole in a metal disc has been derived. Certain special forms of the general equation are considered. C. R. H.

Overvoltage and the structure of the electrical double layer at a hydrogen electrode. G. E. Kimball, S. Glasstone, and A. Glassner (*J. Chem. Physics*, 1941, 9, 91—96).—Application of the theory of abs. reaction rates to electrodes leads to a function for the sp. rate of discharge of ions involving a potential, which, by application of experimental data, is shown to be the overvoltage, whereas the theory requires it to be the total potential. This anomaly is explained by postulating the existence of two different electrical double layers, with corresponding energy barriers, at the electrode surface. If the barrier nearer the electrode is the higher, the overvoltage is essentially established across this layer, whilst the variation in equilibrium potential caused by variations in the [11'] of the solution is established across the outer double layer. Since the rate of discharge is determined by the p.d. across the inner double layer it follows that it is determined by the overvoltage and not by the total potential. Both barriers may correspond with proton transfer from one H_2O mol. to another or, less probably, may correspond with the discharge process in which a H atom is formed. J. W. S.

VIII.—REACTIONS.

Physics of flames and explosions in gases. (A) W. T. David. (B) B. Lewis and G. von Elbe (*J. Appl. Physics*, 1940, 11, 157—158, 158).—(A) Attention is directed to the author's views on "latent energy" (cf. e.g., A., 1941, I, 117). (B) A rejoinder to the above. L. J. J.

Reaction between hydrogen and oxygen: the upper explosion limit and the reaction in its vicinity. G. von Elbe and B. Lewis (*J. Chem. Physics*, 1941, 9, 194—195).—The upper explosion limit of $\text{H}_2\text{-O}_2$ mixtures is decreased considerably by the presence of H_2O vapour. The effect is similar to that of other gases (cf. Grant and Hinshelwood, A., 1933, 909). When the explosion is approached from the high-pressure side short bursts of reaction, dying out rapidly, are observed. This is due to the lowering of the explosion limit by the H_2O formed. Above the upper explosion limit the reaction rate passes through a min. with increasing pressure. The upper limit of explosion at 400—570° is > that found previously (Thompson and Hinshelwood, A., 1929, 403); the low results can be explained by the H_2O -vapour effect. The results also explain the anomalies observed by Oldenberg and Sommers (A., 1940, I, 363). J. W. S.

Thermal reaction between hydrogen and oxygen. H. Third explosion limit. O. Oldenberg and H. S. Sommers, jun. (*J. Chem. Physics*, 1941, 9, 114—117; cf. A., 1939, I, 325).—The thermal high-pressure explosion of a $\text{H}_2\text{-O}_2$ mixture ("third explosion limit") occurring near atm. pressure at

560° has been studied and the upper section of the limiting curve in the p - T diagram has been determined. In accord with previous observation (A., 1931, 320) coating the surface of Pyrex vessels with KCl makes the reaction slower and more reproducible. The results, however, do not decide between different theories of the reaction. J. W. S.

● **Kinetics of reactions in solution.** S. V. Anantakrishnan (*J. Annamalai Univ.*, 1940, 10, 81—104).—A review including collision activation, the transition state, the kinetics of nitration of aromatic compounds, addition of Br_2 and HBr to olefins, mol. rearrangements, onium degradation, and ester hydrolysis. A. J. E. W.

Rate of hydration of isomeric platino-complexes. M. M. Jakschin (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 329—331).—The rates of hydration of isomeric $\text{K}_2[\text{Pt}(\text{S}_2\text{O}_3)_2]$ to $\text{K}_2\text{H}[\text{Pt}(\text{OH})(\text{S}_2\text{O}_3)_2]$ in dil. aq. solution have been compared by following the change of mol. conductivity with time. The change is much more rapid in the case of the more sol. isomeride, which is concluded to be the *cis*-form. L. J. J.

Hydrodynamic problems relating to the processes of combustion and gasification of a layer of combustible solid. B. Kantorovitch (*Compt. rend. Acad. Sci., U.R.S.S.*, 1940, 28, 244—249).—The velocity of reaction between a gas and a solid surface over which it is passing is discussed theoretically, and expressions are derived for the vals. of the apparent velocity coeffs. in various circumstances. J. W. S.

Kinetics of the reduction of carbon dioxide by carbon. V. S. Altschuler and Z. F. Tschuchanov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 706—710).—A three-stage mechanism is proposed: (i) $\text{CO}_2 + \text{C} \rightarrow \text{CO}_2$ (adsorbed); (ii) CO_2 (adsorbed) \rightarrow surface complex C_2O_v ; (iii) $\text{C}_2\text{O}_v \rightarrow \text{CO} + \text{C}$, by thermal decomp.; (iv) $\text{C}_2\text{O}_v + \text{CO}_2$ (gas) $\rightarrow \text{CO} + \text{C}$. (iii) is negligible at atm. pressure. (iv) and (ii) determine the overall velocity and an expression connecting the velocity coeffs. K_{II} and K_{IV} and the energies of activation of these stages with the effective area of the C and the concn. of CO_2 is deduced. Experimental evidence is adduced in support of the conclusion that if $K_{IV}[\text{CO}_2]/K_{II} \ll 1$ the order of reaction is unity and if $\gg 1$ the order is zero. T. H. G.

Kinetic method for the investigation of the intermediate products in autocatalytic reactions. N. N. Semenov and N. M. Emanuel (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 219—223).—On keeping a mixture of H_2S and O_2 in a vessel at 270° for a period $<$ the induction period of the reaction, and then transferring it to another vessel at 300°, the total induction period is such as would be predicted from the combined periods in the two vessels, indicating that the intermediate product is carried over with the gas from one vessel to the other. If, however, the mixture, after having been kept at 270°, is brought into another vessel at 20° before being passed into the vessel at 300°, the induction period in the latter vessel approaches the normal val. as the time of keeping at low temp. is increased. The results indicate that the intermediate compound is decomposed at 20° according to a unimol. law with velocity coeff. 0.007 min^{-1} , whilst the heat of activation of the decomp. is 8500 g.-cal. per mol. J. W. S.

Ozone as oxidation catalyst. Explanation of the favourable effect of dilution of the ozone based on the laws of adsorption. E. Briner (*Helv. Chim. Acta*, 1940, 23, 590—596).—In the oxidation of NaHSO_3 and of aldehydes catalysed by O_3 (cf. A., 1933, 680; 1940, I, 297) the reaction velocity (v) decreases much more slowly than does the concn. (c) of O_3 as the latter is diluted. A linear relation exists between $\log v$ and $\log c$, from which it is inferred that v is \propto the concn. of O_2 in the liquid-gas interface, and that this is related to the bulk concn. in the gas phase according to the Freundlich adsorption isotherm. (Cf. also A., 1941, I, 86.) F. L. U.

Reaction velocities at low temperatures. III. Synthesis of diethyl acetal at temperatures -44° and $+25^\circ$. R. P. Bell and A. D. Norris (*J.C.S.*, 1941, 118—120).—The synthesis of $\text{CHMe}(\text{OEt})_2$ in EtOH in presence of HCl has been studied at -44° to $+25^\circ$. The kinetics are complicated by the equilibrium $\text{EtOH}_2^+ + \text{H}_2\text{O} \rightleftharpoons \text{EtOH} + \text{OH}_2^+$, set up with the H_2O produced in the reaction. When this is allowed for the vals. of k_e , the catalytic coeff. of the EtOH_2^+ ion, follow the Arrhenius equation normally; $k_e = 2.34 \times 10^{13} e^{-15,500/RT}$. F. J. G.

Ammonia synthesis from active nitrogen and hydrogen. S. S. Joshi and A. Purushotham (*Current Sci.*, 1940, 9, 534—535).—A carefully regulated stream of active N was led over a catalyst, followed by a stream of H_2 previously subjected to electrical discharge. Appreciable formation of NH_3 was found with Mg, Cd, Al, S, Cr, and monazite, but the yields with Al_2O_3 , Zn, As, W, Ni, Se, Sn, Co, and Ca were poor. Increased yields were obtained by heating the catalyst, and also the N_2 before activation, to 200°. For successful yields it appears necessary that the nitride formed by the catalyst should be unstable and reactive towards H_2 . W. R. A.

Interactions of gases with metals and crystalline solids. J. K. Roberts (*Physical Soc. Rep. Progr. Physics*, 1940, 7, 303—328).—A progress report. W. J.

Constitution and properties of cyanide plating baths.—See B., 1941, I, 148.

Corrosion of copper electrodes by aqueous iron sulphate containing titanium sulphate.—See B., 1941, I, 146.

Anodic oxidation of aluminium.—See B., 1941, I, 149.

Investigation of lead anodes in the electrolysis of zinc sulphate solutions.—See B., 1941, I, 146.

Electrodeposition of chromium from potassium dichromate baths in presence of fluoride.—See B., 1941, I, 147.

Theory of electrodeposition of chromium.—See B., 1941, I, 147.

Anodic polishing of electroplated nickel.—See B., 1941, I, 147.

Rhodium plating and stripping of rhodium deposits.—See B., 1941, I, 148.

Chemical action of electric discharges. XVIII. Production of formaldehyde in a high- and low-frequency arc. E. Briner and H. Hoefler (*Helv. Chim. Acta*, 1940, 23, 800—806).—The mixtures studied were CO-H_2 , CO-CH_4 , CH_4 - O_2 , C_3H_8 - O_2 , and C_4H_{10} - O_2 , all at 40—50 mm. pressure. Increase in the frequency (ν) of the a.c. arc results in a marked increase in the amount of CH_2O formed, which, at $\nu = 50$ per sec., is always < 1 g. per kw.-hr. The best results were obtained with CH_4 - O_2 (O_2 4%) mixtures, which at $\nu = 10^7$ per sec. gave 16.6 g. of CH_2O per kw.-hr. Alcohols, ketones, other aldehydes, and (in presence of CH_4) C_2H_2 are formed in side-reactions. F. L. U.

Optical sensitising of silver halides by dyes. III. Relation of sensitising to the absorption spectra and constitution of dyes. S. E. Sheppard, R. H. Lambert, and R. D. Walker (*J. Chem. Physics*, 1941, 9, 96—113; cf. A., 1939, I, 315, 480; 1940, I, 367).—Various investigations of the differences between the absorption spectra of sensitising dyes when adsorbed on Ag halides and when in EtOH solution are summarised. The spectra of the adsorbed dyes correspond with their spectra in solution, and are similarly affected by structural changes, but they are shifted to longer λ . Similar shifts, however, are produced on comparing the spectra of solutions in different solvents, and it is pointed out that it is the displacement relative to the absorption bands for the dye in the gaseous state at low pressure which should correspond with an adsorption energy available for sensitisation. Such energy difference, however, is generally insufficient. The essential requirements for "mol." sensitisation are (i) planar configuration of the dye mol. and adsorbed dye ions, (ii) edge-on adsorption of planar molcs., oriented possibly orthogonally but more probably at 70° to the (111) plane of the crystal, and (iii) electronic transition in the dye ion or dipole on absorption of a photon polarised in an azimuth defined by (i) and (ii). A hypothesis of coplanar coupling of electronic displacements in the dye and in a congruent plane of the Ag halide lattice is advanced, and is considered to be the key factor for both mol. and aggregate optical sensitisation by dyes. The influence of nuclear changes and of substituents on the sensitising action is discussed. J. W. S.

Isomeric transformation of chromium chloride in the dark and in ultra-violet light. D. S. Datar and M. Qureshi (*J. Osmania Univ.*, 1940, 8, 6—20).—The isomerisation of dark green $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$ in aq. solution may be followed by observation of extinction coeffs., p_H , and Λ ; at -25° , in the dark, these attain const. vals. after $\sim 6\frac{1}{2}$ hr. On exposure to ultra-violet light the changes are accelerated, and moreover

a solution which has reached equilibrium in the dark undergoes further change on irradiation. F. J. G.

Photochemical reaction in the region of electron affinity spectrum of chromous ions in solution. B. Dain and E. Liberzon (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 228—230).—When CrSO_4 solutions are exposed to the light of a Hg-vapour lamp, H_2 is evolved owing to the reaction $\text{Cr}^{++} + \text{H}_2\text{O} \rightarrow \text{Cr}^{+++} + \text{OH}^- + \text{H}$. The reaction is not produced by light of λ 3660 or 3130 \AA ., and apparently corresponds with the absorption region at $<3000 \text{\AA}$. After an initial induction period, corresponding with the saturation of the solution with H_2 , the evolution of H_2 occurs at a const. rate which is almost independent of temp. J. W. S.

Mechanism of the primary photodissociation of organic molecules. E. Bergmann and R. Samuel (*J. Org. Chem.*, 1941, 6, 1—24).—An extended account of work already abstracted (A., 1938, I, 341). Special reference is made to CH_3O , HCO_2H , AcOH , EtOAc , $\text{MeCO}\cdot\text{SH}$, MeCS_2H , $\text{CS}(\text{NH}_2)_2$, MeCHO , EtCHO , COMe_2 , CH_2Ac_2 , Ac_2 , $\text{CH}_2\text{Ac}\cdot\text{CO}_2\text{Et}$, and AcOH . H. W.

Effect of neutrons on photosynthesis.—See A., 1941, III, 314.

IX.—METHODS OF PREPARATION.

Genesis of chemical reactions. N. S. Akulov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 135—138).—A theory of the autogenesis of reactions is developed. O. D. S.

Salts. M. Usanovitch (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 438—440).—Salts may be regarded as derived from bases (anions), but not from acids. Thus, NaCl is a salt of a base (Cl^-) but not of HCl . The reactions: $\text{NaOEt} + \text{EtCl} \rightarrow \text{NaCl} + \text{Et}_2\text{O}$, $\text{NaOEt} + \text{AcCl} \rightarrow \text{NaCl} + \text{EtOAc}$, $\text{NaOAc} + \text{AcCl} \rightarrow \text{NaCl} + \text{Ac}_2\text{O}$, $\text{Na}_2\text{SO}_3 + \text{SOCl}_2 \rightarrow 2\text{NaCl} + 2\text{SO}_2$, may all be regarded as methods of salt formation, and are analogous to $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$, so that NaCl may be regarded as the salt of the base NaOAc and the acid AcCl . Solvolysis of a salt depends entirely upon the solvent. NaCl is alkaline in Ac_2O solution, the acid produced (AcCl) being weaker than the base (NaOAc). A. J. M.

Absolute water and its use. J. Koppányi (*J. Hung. Chem. Soc.*, 1940, 1, No. 3, 12—13).—Austerweil's method for the purification of H_2O by reversible acid or base exchange for OH^- or H^+ with insol. basic or acidic compounds, "alassions" (I), is described. Only very weak acids are not removed by (I), which is regenerated with H_2SO_4 or aq. NH_3 , respectively. H_2SiO_3 in the H_2O is first pptd. with NaAlO_2 , and CO_2 must be removed. E. V. A.

Use of copper and brass tubes [for water supplies].—See B., 1941, III, 83.

Reaction of hydrogen and oxygen in the presence of silver. Third explosion limit. H. R. Heiple and B. Lewis (*J. Chem. Physics*, 1941, 9, 120).—When Ag is arranged at the centre of a tube heated at $625\text{--}660^\circ$ no change is observed when H_2 is passed through the tube, but when O_2 is passed through the tube an orange-brown deposit appears on the tube walls. When a $\text{H}_2\text{--O}_2$ mixture is passed through the tube a greenish-brown deposit is formed of outline similar to that of the Ag used. The intensity of the deposit in the latter case may be due, not only to the formation of a volatile Ag oxide, but also to sputtering of Ag atoms through the reaction at its surface. Hence the suppression of the chain reaction at 700° in a Ag vessel (A., 1933, 469) may be due to chain-breaking through the action of Ag atoms in the gas phase. J. W. S.

Washing reclaimed silver nitrate crystals with alcohol leads to explosion. J. P. Tully (*Canad. Chem.*, 1941, 25, 90).—A dangerous explosion occurred when $\sim 0.75 \text{ lb.}$ of moist AgNO_3 crystals, obtained from AgCl residues by dissolving the button of Ag from the Na_2CO_3 fusion in HNO_3 and crystallising, had been washed with EtOH denatured with 10% COMe_2 , and were touched with a spatula. The detonation was due to the formation of AgONC . Methods for eliminating the EtOH washing are suggested. L. S. T.

Influence of humidity on atmospheric corrosion of zinc, aluminium, and iron coated with electrolytes.—See B., 1941, I, 146.

Preparation of base-exchange materials from some British clays and minerals.—See B., 1941, I, 117.

Mixed platinum triammino-thiosulphates. D. I. Riabtschikov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 236—239).—Treatment of *trans*- $[\text{Pt}\{\text{CS}(\text{NH}_2)_2\}_2(\text{NH}_3)_2]\text{Cl}_2$ (0.3 g.) with aq. $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ (I) (0.1645 g.) yields a white cryst. ppt. of the compound, *trans*- $[\text{Pt}\{\text{CS}(\text{NH}_2)_2\}_2(\text{NH}_3)_2(\text{S}_2\text{O}_3)]$. With 0.329 g. of (I) no ppt. is produced owing to the formation of the sol. *trans*- $\text{Na}_2[\text{Pt}(\text{NH}_3)_2(\text{S}_2\text{O}_3)_2]$. Treatment of a hot solution of *trans*- $[\text{Pt}(\text{C}_6\text{H}_5\text{N})_2\{\text{CS}(\text{NH}_2)_2\}_2]\text{Cl}_2$ (0.3 g.) with (I) (0.1743 g.) yields a white cryst. ppt. of the compound, *trans*- $[\text{Pt}(\text{C}_6\text{H}_5\text{N})_2\{\text{CS}(\text{NH}_2)_2\}_2(\text{S}_2\text{O}_3)]$. Excess of (I) had no further effect. With *trans*- $[\text{Pt}(\text{NH}_3)_2(\text{C}_6\text{H}_5\text{N})_2]$ (0.3 g.), (I) (0.1625 g.) yields slowly small prisms of the compound, *trans*- $[\text{Pt}(\text{NH}_3)_2(\text{C}_6\text{H}_5\text{N})_2(\text{S}_2\text{O}_3)]$. With 0.325 g. of (I) there is slow formation of *trans*- $\text{Na}_2[\text{Pt}(\text{NH}_3)_2(\text{S}_2\text{O}_3)_2]$, which on addition of BaCl_2 and H_2SO_4 yields a light cream ppt. of the compound, *trans*- $\text{Ba}[\text{Pt}(\text{NH}_3)_2(\text{S}_2\text{O}_3)_2]$. By treatment of this salt with H_2SO_4 it has been shown that the corresponding acid (II) is a strong acid, a 0.005M. solution having p_H 2.05. Treatment of the acid with $[\text{Pt}(\text{NH}_3)_4]\text{Cl}_2$ yields a cryst. ppt. of the compound, *trans*- $[\text{Pt}(\text{NH}_3)_4][\text{Pt}(\text{NH}_3)_2(\text{S}_2\text{O}_3)_2]$. With *trans*- $[\text{Pt}(\text{NH}_3)_2(\text{C}_6\text{H}_5\text{N})_2]\text{Cl}_2$ (III) (0.3 g.), (I) (0.2056 g.) and $\text{CS}(\text{NH}_2)_2$ (0.063 g.) yield a white ppt. of the compound, $[\text{Pt}(\text{NH}_3)_2(\text{S}_2\text{O}_3)]_2[\text{C}_6\text{H}_5\text{N}]\{\text{CS}(\text{NH}_2)_2\}$. With (I) (0.4112 g.), (III) (0.3 g.) yields *trans*- $\text{Na}_2[\text{Pt}(\text{C}_6\text{H}_5\text{N})(\text{NH}_3)(\text{S}_2\text{O}_3)_2]$, which with $[\text{Pt}\{\text{CS}(\text{NH}_2)_2\}_2]\text{Cl}_2$ yields golden yellow needles of the compound, *trans*- $[\text{Pt}\{\text{CS}(\text{NH}_2)_2\}_2][\text{Pt}(\text{C}_6\text{H}_5\text{N})(\text{NH}_3)(\text{S}_2\text{O}_3)_2]$. The compound, *trans*- $\text{Ba}[\text{Pt}(\text{C}_6\text{H}_5\text{N})(\text{NH}_3)(\text{S}_2\text{O}_3)_2]$, is almost white and with H_2SO_4 yields a solution of the free acid, similar in properties to (II). J. W. S.

Reaction of thiosulphate with isomeric compounds of bivalent platinum. D. I. Riabtschikov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 231—235).—Treatment of *trans*- $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ (0.3 g.) with hot aq. $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ (I) (0.248 g.) yields a turbid solution which deposits the sparingly sol. compound, *trans*- $[\text{Pt}(\text{NH}_3)_2(\text{S}_2\text{O}_3)(\text{H}_2\text{O})]$. The H_2O is very firmly held and is not removed by drying at 110° . With 0.496 g. of (I), however, no ppt. is formed owing to the production of the sol. *trans*- $\text{Na}_2[\text{Pt}(\text{NH}_3)_2(\text{S}_2\text{O}_3)_2]$, whilst with $<1.98 \text{ g.}$ of (I) the solution turns yellow owing to the production of $\text{Na}_6[\text{Pt}(\text{S}_2\text{O}_3)_4]$ (II). When *cis*- $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ (III) (0.3 g.) is treated with (I) (0.248 g.) the solution turns yellow owing to the formation of *cis*- $\text{Na}[\text{Pt}(\text{NH}_3)_2(\text{S}_2\text{O}_3)\text{Cl}]$ (IV), which on treatment with $[\text{Pt}(\text{NH}_3)_4]\text{Cl}_2$ (V) or $[\text{Pt}\{\text{CS}(\text{NH}_2)_2\}_2]\text{Cl}_2$ yields ppts. of the compounds, *cis*- $[\text{Pt}(\text{NH}_3)_4][\text{Pt}(\text{NH}_3)_2(\text{S}_2\text{O}_3)\text{Cl}]$ and *cis*- $[\text{Pt}\{\text{CS}(\text{NH}_2)_2\}_2][\text{Pt}(\text{NH}_3)_2(\text{S}_2\text{O}_3)\text{Cl}]$, respectively. Addition of saturated aq. KCl and EtOH to the original solutions immediately after mixing causes pptn. of the compound, *cis*- $\text{K}[\text{Pt}(\text{NH}_3)_2(\text{S}_2\text{O}_3)\text{Cl}]$. When (IV) is kept in solution a yellowish powdery ppt. of the compound, $[\text{Pt}(\text{NH}_3)_2(\text{S}_2\text{O}_3)]$, gradually separates. When (III) (0.3 g.) is treated with (I) (0.496 g.) *cis*- $\text{Na}_2[\text{Pt}(\text{NH}_3)_2(\text{S}_2\text{O}_3)_2]$ is formed, this on treatment with (V) yielding a ppt. of the compound, *cis*- $[\text{Pt}(\text{NH}_3)_4][\text{Pt}(\text{NH}_3)_2(\text{S}_2\text{O}_3)_2]$. The compound, *cis*- $\text{K}_2[\text{Pt}(\text{NH}_3)_2(\text{S}_2\text{O}_3)_2]$, has also been isolated. With excess of (I), (III) yields (II). The behaviour of these complexes is compared with that of the $\text{CS}(\text{NH}_2)_2$ complexes. J. W. S.

X.—ANALYSIS.

Isotopes as indicators. C. Rosenblum (*J. Chem. Educ.*, 1940, 17, 567—570).—A review. L. S. T.

Application of colorimetric methods to metallurgical analysis.—See B., 1941, I, 149.

Improvement in mixing starch solution. N. M. Cullinane (*Chem. and Ind.*, 1941, 146).—If 1 g. of starch is mixed to a cream with a little H_2O , and 100 c.c. of boiling H_2O added, the solution may be kept for three months without deteriorating. Addition of 2 drops of conc. HCl or 1 g. of ZnCl_2 is an improvement. F. J. G.

Mixing starch solution. R. C. Terry (*Chem. and Ind.*, 1941, 185).—0.1% of HgI_2 or Shirian (an anti-mildew agent for cotton) preserves 1% starch paste for an indefinite period. Neither preservative interferes with the K_2PtI_6 test for mustard gas. A. J. E. W.

Determination of fluorine. P. A. Clifford (*J. Assoc. Off. Agric. Chem.*, 1940, 23, 303—307).—The titration of F with

Th(NO_3)₃ in the presence of alizarin as indicator is not successful for the determination of amounts <50 μg . The dil. Th solution (0.0004N.) used does not give a satisfactory end-point with the indicator; neutral salts also affect the end-point. A suitable procedure to eliminate these errors is suggested. F combines with Al to form AlF_6^{3-} , which interferes with the formation of the Al aluminon lake. Under standard conditions the bleaching of the coloured lake $\propto [\text{F}]$.
E. C. B. S.

Thorium nitrate titration of micro-quantities of fluorine in aqueous and alcoholic systems. J. W. Hammond and W. H. Macintire (*J. Assoc. Off. Agric. Chem.*, 1940, 23, 398–404).—Titration of F' by Th(NO_3)₄ in 48% EtOH adjusted to p_{H} 3.0 with HCl gives stoichiometric results in both μg and mg. ranges. Na alizarinsulphonate is used as indicator. A similar titration in aq. solution, or in 48% EtOH in the presence of a $\text{CH}_2\text{Cl}-\text{CO}_2\text{H}-\text{CH}_2\text{Cl}-\text{CO}_2\text{Na}$ buffer, gives high results in the μg . range.
E. C. B. S.

Determination of nitrates (in water) by the phenoldisulphonic acid method. J. S. Dunn (*Analyst*, 1941, 66, 105).—The colours of the B.D.H. Nessleriser Disc for the determination of free Cl_2 by means of *o*-tolidine provide good matches for the yellow tints obtained in the phenoldisulphonic acid method of determining >0.01 mg. of $\text{NO}_3^- \cdot \text{N}$.
L. S. T.

Determination of small quantities of hydroxylamine by Blom's method. H. Barnes (*J. Marine Biol. Assoc.*, 1941, 25, 109–110).— NO_2^- in very dil. solution is not recovered quantitatively by Griess' method after treatment with Blom's reagents for the determination of NH_2OH because of the presence of $\text{S}_2\text{O}_3^{2-}$, very small quantities of which interfere with the colour reaction.
J. L. D.

Spectrographic determination of phosphorus in phosphor-bronze.—See B., 1941, I, 146.

How technique for micro-determination of arsenic. T. Wilkinson and C. G. Greenham (*Austral. J. Exp. Biol.*, 1940, 18, 341–342).—How's procedure (A., 1938, I, 322) is modified. An alloy containing Zn 99.5, Sn 0.5, Pb 0.1, Fe 0.1 g. is used; 0.125% HgCl_2 solution is preferable, and a wringer giving reproducible pressure is necessary. 2 ml. of 5% $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$, slightly acidified (H_2SO_4), is placed in each generation tube; after adding the digested material and aq. NaHSO_3 and diluting, 0.2 c.c. of 40% SnCl_2 in conc. HCl is added. Freshly impregnated string is essential.
D. M. N.

Determination of arsenic. C. C. Cassil (*J. Assoc. Off. Agric. Chem.*, 1940, 23, 297–301). In Cassil and Wichmann's method (B., 1939, 1173) it is desirable to omit the addition of KI (reagent *g*) and to prepare reagent *k* from sol. starch; the Zn should be 20-mesh, and SnCl_2 should not be added before the final dilution is made.
E. C. B. S.

Interference of selenium and tellurium with the determination of arsenic by the hypophosphorous acid method. H. J. G. Challis (*Analyst*, 1941, 66, 58–60).—In presence of Se and Te, the determination of As in Cu by Evans' method (A., 1932, 1010) yields high results. In a modified method the sample (5 g.) is dissolved, without boiling, in dil. H_2SO_4 (30 ml.) and conc. HNO_3 (15 ml.), and the solution is evaporated until the CuSO_4 becomes grey. The residue is warmed with dil. HCl (150 ml.), NaH_2PO_2 (3 g.) is added to decolorise the Cu salts, and the solution is warmed to 50°. In presence of Se or Te a red or brownish colour or ppt. is formed, and persists after the addition of 1–2 g. more NaH_2PO_2 . The solution is maintained at 50° for 30 min., and the ppt. is separated, and washed with dil. HCl. The filtrate is treated with more NaH_2PO_2 and the As determined by Evans' method.
J. W. S.

Qualitative semimicro-analysis with reference to Noyes and Bray's system: the thallium group. C. C. Miller (*J.C.S.*, 1941, 72–75).—Working details are given of a scheme for the detection and determination of 0.25–50 mg. of Ag and Pb, 0.25–10 mg. of Tl, and some Bi, in mixtures containing >50 mg. of the metals. The scheme involves dissolution of the bromides in HBr, detection of Tl with rhodamine-B, extraction of TlBr_3 by means of Bu^+OAc , detection of Ag in a CN^- solution with *p*-dimethylaminobenzylidenethiodaniline, detection of Bi and Pb with $\text{CS}(\text{NH}_2)_2$, and confirmation of Pb as rhodizonate.
F. J. G.

Spectroscopic analysis of enamel frits.—See B., 1941, I, 137.

Micro-determination of calcium and magnesium [in soil].—See B., 1941, III, 61.

Determination of lead in drinking water.—See B., 1941, III, 83.

Assay of lead oleate plaster and ointment.—See B., 1941, III, 76.

Determination of copper as the diethyl dithiocarbonate complex. D. L. Drabkin (*J. Assoc. Off. Agric. Chem.*, 1940, 23, 301–302).—A photometric procedure was applied to a solution of the complex in isoamyl acetate; the effect of contamination with Bi, Co, and Ni was studied.
E. C. B. S.

Electrolytic determination of copper in steel.—See B., 1941, I, 145.

Micro-cerimetric determination of electrolytic copper.—See B., 1941, I, 146.

Analysis of mercury ores.—See B., 1941, I, 147.

Assay of mercuric oxide ointment.—See B., 1941, III, 70.

Spectrographic analysis of aluminium alloys.—See B., 1941, I, 148.

Determination of ferric and ferrous iron. J. O. Percival (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 71–72).—A rapid (10 min.) method for determining Fe^{3+} in $\text{Fe}_2(\text{SO}_4)_3$ pickling baths for brass and other Cu alloys is described, and shown to be accurate by comparison with the SO_2 and SnCl_2 reduction methods. Pptd. Cu powder is used as reducing agent in the cold, and the reduced solution is titrated with 0.1N- KMnO_4 . Large amounts of Fe^{2+} , Cu^{2+} , Mn^{2+} , Ni^{2+} , and Cr^{3+} do not interfere; Cl^- must be absent.
L. S. T.

Determination of iron by the Zimmerman-Reinhardt method. Effects of temperature, and determination of blank. W. R. Crowell, W. W. Luke, and T. G. Mastin (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 94–95).—Comparison of data obtained by the Zimmerman-Reinhardt and Jones reductor methods shows that between 10° and 40° the results by the former method are practically unaffected by temp. during the treatment with HgCl_2 . Titration with KMnO_4 is better done at 30° than at 10°. In the procedure detailed, the blank is unaffected by temp. (10–40°) and by the amount of SnCl_4 , but it is dependent on the vol. of the solution, the amount of preventive solution, and particularly on the amount of FeCl_3 present. Under optimum conditions the results obtained by the Zimmerman-Reinhardt method were 0.08% > those obtained with the Jones reductor.
L. S. T.

Basic sulphates of iron and aluminium in analytical separations. J. G. Fairchild (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 83; cf. A., 1934, 628).—Excess of Fe^{3+} , together with some Al^{3+} , is separated from bivalent metals by pptn. as basic $\text{K Fe}^{III}\text{alum}$. A slightly acid solution of $\text{Fe}_2(\text{SO}_4)_3$, free from F^- , Cl^- , or NO_3^- , is treated with KHSO_4 , and neutralised with dil. aq. NH_3 until a slight ppt. persists. The solution is heated in a closed flask immersed in steam for several hr.; ~5 mg. of Fe remain in solution. Ni and Zn can then be determined in the filtrate by the procedures described.
L. S. T.

Photometric determination of iron.—See A., 1941, III, 315.

Polarographic determination of nickel and cobalt. Simultaneous determination in presence of iron, copper, chromium, and manganese, and determination of small amounts of nickel in cobalt compounds. J. J. Lingane and H. Kerlinger (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 77–80).—The half-wave potential of Ni is 0.3 v. more positive than that of Co in supporting electrolytes containing $\text{C}_5\text{H}_5\text{N}$ (I) or CNS^- , and the separation of the two waves permits the simultaneous determination of both metals. An electrolyte containing (I) is preferred to one containing CNS^- . With the latter, the diffusion current of Co shows irregularities, especially in solutions containing acid or NH_4^+ . In an electrolyte of ~ p_{H} 5.4 containing equal concns. of (I) and a pyridinium salt, Fe^{3+} is separated sharply from small amounts of Ni, Co, and Cu, by pptn. as $\text{Fe}_2\text{O}_3 \cdot n\text{H}_2\text{O}$. Ni^{2+} and Co^{2+} are not co-pptd., and the method is suitable for the simultaneous determination of Ni and Co in steel. Moderate amounts of Cr^{3+} in steel are co-pptd. completely with the $\text{Fe}_2\text{O}_3 \cdot n\text{H}_2\text{O}$. Mn^{2+} and small amounts of Cu^{2+} do not interfere. Cu gives a double wave at +0.05 and -0.25 v. against the saturated Hg_2Cl_2 electrode in (I), and large amounts must be removed

before the Ni-Co determination. Small amounts of Ni impurities in Co compounds can be rapidly and accurately determined in an electrolyte containing (I) or CNS'.

L. S. T.

Rapid detection of chromium in stainless steels, other high-chromium alloys, and plating.—See B., 1941, I, 145.

Determination of chromates in sewage liquors.—See B., 1941, III, 82.

Precipitation of stannic sulphide. W. C. G. Wheeler (*Analyst*, 1941, 66, 61).—In absence of Fe and metals other than Sn pptd. by H_2S in acid solution, NH_4 tartrate should be added before pptg. SnS_2 with H_2S . The ppt. is voluminous but not difficult to handle, but the addition of a little aq. SO_2 towards the end of the saturation with H_2S granulates the ppt.

J. W. S.

Electrolytic determination and separation of bismuth. III. Determination and separation from copper in alkaline solution. F. G. Kny-Jones (*Analyst*, 1941, 66, 101—104).—Rapid and accurate determinations of Bi alone or in presence of Cu can be made in alkaline tartrate solutions containing $(NH_4OH)_2H_2SO_4$ as depolariser. Other depolarisers are unsuitable; N_2H_4 salts or glucose cause blackening, citrates and formates fail to prevent the formation of the pentoxide, and quinol leads to low results. CH_3O leads to the formation of colloidal Bi (cf. *J.C.S.*, 1907, 91, 373). Procedure and test data are given.

L. S. T.

XI.—APPARATUS ETC.

Temperature and temperature scales. H. T. Wensel (*J. Appl. Physics*, 1940, 11, 373—387).—A survey of fundamental concepts of, and methods of expressing, temp. The basis and significance of a thermodynamic scale are discussed, and its relation to various practical scales, in particular the International temp. scale, is explained.

N. M. B.

Temperature scale; proposed change in definition. F. G. Brickwedde (*J. Appl. Physics*, 1940, 11, 371—372).—The Joule-Thomson definition of temp. scale based on considerations of ideal gases may be completed by assigning an arbitrarily chosen no. to either the temp. of some one reproducible thermal state, or to the difference between the temp. of two states. The former is advocated to supersede the latter, and advantages are discussed.

N. M. B.

Thermoelectric thermometry. W. F. Roeser (*J. Appl. Physics*, 1940, 11, 388—407).—A comprehensive review of fundamental laws and theories, their historical development, and application to temp. measurement. Thermocouples and their use are examined from the practical viewpoint.

N. M. B.

Wheatstone bridge circuits for automatic temperature regulators. F. W. Jones (*J. Sci. Instr.*, 1941, 18, 48—49).—In the two circuits described some of the more expensive units are replaced with the less expensive potentiometers and multi-tapping switches supplied by radio-component manufacturers.

C. R. H.

Accurate constant-temperature bath and storage cabinet for operation below room temperature. R. M. Dolby (*New Zealand J. Sci. Tech.*, 1940, 22, 49—51b).—A refrigerator unit is used to cool an auxiliary bath, from which cold H_2O is admitted to the const.-temp. bath through an electromagnetically-operated thermostatic valve. A pump which also provides the necessary stirring returns excess of H_2O to the auxiliary bath. The temp. control of the bath is accurate to $\pm 0.05^\circ$ at $5-15^\circ$, whilst the temp. inside a storage compartment immersed in the thermostat is $> 0.1^\circ$ above the temp. of the H_2O except immediately after opening. The apparatus was devised for investigations on butter.

J. W. S.

Temperature radiation emissivities and emittances. A. G. Worthing (*J. Appl. Physics*, 1940, 11, 421—437).—Methods of measuring the various emissivities (normal, hemispherical, spectral, total, luminous, and colour) and corresponding emittances of substances are reviewed. Available data for 15 metals are tabulated and general tendencies indicated thereby are summarised.

N. M. B.

Optical pyrometry. W. E. Forsythe (*J. Appl. Physics*, 1940, 11, 408—420).—A review of the principle and construction of pyrometers, use of monochromatic screens, rotat-

ing sectors, and absorbing screens. Calibration and accuracy tests are described, and practical data are tabulated and plotted.

N. M. B.

Inexpensive polarising device for microscopes. H. A. Derow (*J. Lab. clin. Med.*, 1941, 26, 694—695).—Pieces of polaroid film are fitted in the eyepiece and beneath the condenser.

C. J. C. B.

Photo-electric fluorimeter and some applications. F. Kavanagh (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 108—111).—In the arrangement described the fluorescence of an unknown solution is measured in terms of that of a standard. Uncertainties due to fluctuations and drifts of lamp intensity, non-linear galvanometer scale, and inconstancy of galvanometer response are eliminated. The galvanometer is used as a null-point indicator, and the ratio of the fluorescence of the unknown to that of the standard is indicated by a potentiometer. The instrument has been tested by determinations of thiamin, riboflavin, chlorophyll, and Al.

L. S. T.

Ultra-violet photometer. Quantitative measurement of small traces of solvent vapours in air. V. F. Hanson (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 119—123).—The photometer measures low concns. of tri- (10 p.p.m.) and per-chloroethylene (0.3 p.p.m.) in air, and is applicable to low concns. (< 0.13 p.p.m.) of many toxic org. vapours. Details of the principles of operation, construction, and application are described and illustrated.

L. S. T.

Colour comparator. R. H. Wilhelm (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 123).—The comparator described utilises the property of acrylate or methacrylate resins of transmitting light through curved bars without appreciable loss. Two bars curved at one end and enclosing Al foil as a reflector at the straight ends are cemented together, and serve to bring colour images into adjacent fields.

L. S. T.

(A) Device for rocking a crystal in a vacuum X-ray spectrograph. (B) Simple design for the crystal support assembly in a vacuum X-ray spectrograph. J. W. McGrath (*Rev. Sci. Instr.*, 1940, 11, 396).—(A) The crystal table is rotated by a lever and cam, the lever passing out of the vac. chamber through a small brass bellows.

(B) The table is mounted on a shaft, which is held in position by two precision radial bearings, 4 in. apart. The bearings are housed in a heavy brass mounting and the whole assembly is enclosed in a vac.-tight brass can soldered to the underside of the spectrograph.

D. F. R.

Simplified system of buffers and indicators with or without glass electrodes. J. F. McClendon (*J. Lab. clin. Med.*, 1940, 26, 568—575).

C. J. C. B.

Tungsten-nickel and tungsten-silver electrode systems in neutralisations. H. G. Dietrich and P. J. Bender (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 105—107).—The data recorded show that the W-Ni electrode system is satisfactory for the titration of strong acids in 0.1N. concns. (cf. A., 1933, 572), but is of little val. in titrating 0.01N. solutions. The W-Ag system gives precise and accurate end-points in titrations of strong acids by strong bases in 0.001N. solutions, and vice versa in 0.01N. solutions. At higher concns. the system is of val. in the neutralisation of strong acids by aq. NH_3 , of AcOH by a strong base, and of Na_2CO_3 .

L. S. T.

Stroboscope and circuit for charging condensers to high direct current potentials. G. H. Wagner and W. G. Eversole (*J. Chem. Educ.*, 1940, 17, 587—588).

L. S. T.

Spring pendulum current interrupter for a magnetic stirrer, with application to an experiment in catalysis. V. A. Lamb and M. M. Haring (*J. Chem. Educ.*, 1940, 17, 577—579).—The construction of an interrupter for use with a magnetic stirrer is described and illustrated. The stirrer has been applied to investigating the decomp. of H_2O_2 catalysed by 0.05N-KI.

L. S. T.

Quantum efficiency of Geiger-Müller counters for X-ray intensity measurements. H. M. Sullivan (*Rev. Sci. Instr.*, 1940, 11, 356—362).—The counting rate increases when the photons exciting the counter possess sufficient energy to excite radiations from the cathode material (Zr), the increase occurring at the crit. Zr K absorption limit. The quantum efficiency for an A- O_2 -filled counter is 5.7% when excited by Mo $K\alpha_1\alpha_2$ radiation and 15.7% when excited by Mo $K\beta_1\beta_2$ radiation; the corresponding vals. for a H_2 -filled

counter are 4.0 and 15.0%. Abs. X-ray intensity measurements made with the two counters agree to within 3%.

D. F. R.

Low-capacity coupler for cathode-ray oscilloscope. W. P. Overbeck and J. L. C. Löf (*Rev. Sci. Instr.*, 1940, 11, 375—376).—The voltage to be observed modulates an oscillator isolated from earth and the resulting output is loosely coupled to a detector built into the oscilloscope. This eliminates disturbance in high-impedance circuits by the relatively low impedance to earth of one of the oscilloscope amplifier input terminals.

D. F. R.

Recorder for electric potentials. Damping of piezoelectric systems. F. Offner (*J. Appl. Physics*, 1940, 2, 347—352).—The phase-frequency, amplitude-frequency, and transient characteristics of a Rochelle salt ink-writing oscillograph are calc. The insertion of a series resistor improves these characteristics but cannot achieve crit. damping as the necessary coeff. of coupling, >0.943 , is unobtainable in a crystal. Comparison with a cathode-ray oscillograph record of a bioelectric potential is given.

D. F. R.

Chemical applications of the mass-spectrograph. W. Wahl (*Finska Kem. Medd.*, 1940, 49, 18—41).—A review.

M. H. M. A.

Tests to indicate the condition of an analytical balance. L. C. Kreider (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 117—118).—Double weighings by Gauss' method are made with loads of 10 to 100 g. on each pan and the constancy of rest-point and the sensitivities are examined from the data obtained.

L. S. T.

Calibration of volumetric apparatus. C. R. Johnson (*J. Chem. Educ.*, 1940, 17, 582—583).—A method of calibrating this apparatus with H_2O as a reference standard is described.

L. S. T.

Fractional distillation column. H. R. Snyder and R. L. Shriner (*J. Chem. Educ.*, 1940, 17, 588—590).—Laboratory apparatus is described, and its use illustrated.

L. S. T.

Distillation of foaming solutions under vacuum. D. R. Rexford (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 95—96).—In the apparatus and method described, bubble formation is arrested and built-up foam masses are destroyed by means of fluctuations in the reduction of pressure employed.

L. S. T.

Semimicro- and micro-Kjeldahl steam distillation unit. J. H. Brant and D. C. Sievers (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 133).—A simpler and more flexible form of Kirk's apparatus (A., 1930, 955) is described and illustrated.

L. S. T.

Trends in design of fractionating pumps. K. C. D. Hickman (*J. Appl. Physics*, 1940, 11, 303—313).—A review.

D. F. R.

Large molecular pumps of the disc type. S. von Friesen (*Rev. Sci. Instr.*, 1940, 11, 362—364).—A description of Siegbahn pumps, including one used in cyclotron work, capable of pumping at 73 l. per sec. at 10^{-3} mm. Hg at 3700 r.p.m.

D. F. R.

X-Ray method of determining rates of diffusion in the solid state. J. DuMond and J. P. Youtz (*J. Appl. Physics*, 1940, 11, 357—365).—Artificially stratified layers, 100 Å. thick, of Au and Cu, produced by controlled evaporation in vac., were subjected to Mo K radiation. The intensity of the diffracted image from these stratified films showed a gradual decay, with a half-life period of 2 days, due to the diffusion of Au through Cu. By measuring the rate of this decay, a rapid and accurate method of determining the rates of diffusion in the solid state is made possible. The diffusion coeff. of Au through Cu at room temp. is 5×10^{-20} cm.² sec.⁻¹

D. F. R.

Measurement of tension in liquids by means of a metal bellows. R. S. Vincent (*Proc. Physical Soc.*, 1941, 53, 126—140).—An historical review is given. A metal bellows, closed by a needle valve, contains the liquid under test and is completely surrounded by the liquid to exclude inward atm. leakage. An increasing tensile load is applied to the bellows until the liquid breaks, and the hydrostatic tension prior to breaking is calc. Data at 0—30° for EtOH, Et₂O, and mineral oil are reported.

N. M. B.

Measurement of surface tension by the ripple method. E. Tyler (*Phil. Mag.*, 1941, [vii], 31, 209—221).—Various graphical methods are suggested for obtaining the surface tension of a liquid by the measurement of ripples, and the

use of the modified Kelvin equation. Three stroboscopic methods for measuring the frequency of ripple formation over a wide range of frequencies (20—400 per sec.) are described. The results agree well with those obtained by other methods.

A. J. M.

Method for measuring the internal area of section of a glass tube. D. J. Behrens (*Phil. Mag.*, 1941, [vii], 31, 199—203).—An optical method for carrying out the above determination is described. It has the advantage of giving the area of section at a given point. It is also possible to find μ for the material of the tube if the end is accessible.

A. J. M.

Centrifuge accessories. C. R. Johnson and H. Miller (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 118).—Cups with perforated bottoms or interchangeable perforated plates are made from Lucite, and serve for the centrifugal drainage of crystals.

L. S. T.

Rapid method for calibration of flowmeters. H. J. Neuron (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 114).— H_2O from a constant-head device forces gas from a cylinder through the flowmeter. Hg or oil can replace H_2O .

L. S. T.

Capillary tube experiments with gases. L. J. Kay (*J. Chem. Educ.*, 1940, 17, 580—581).—Capillary apparatus for demonstrating the thermal dissociation of $CaCl_2 \cdot 4NH_3$ or $ZnCl_2 \cdot 4NH_3$, and for comparing the v.d. of two liquids, is described.

L. S. T.

Mixture of bakelite and metal powder for mounting microspecimens. N. J. Finsterwalder (*Mel. Progr.*, 1940, 38, 294—295).—A conductive mounting medium permitting the electrical etching or polishing of microspecimens consists of a mixture of bakelite with Cu or Al powder.

R. B. C.

Apparatus for the direct measurement of the absorption of sound in gases. R. W. Leonard (*Rev. Sci. Instr.*, 1940, 11, 389—393).—The absorption coeff. is calc. from pressure-distance curves obtained by moving a microphone away from a piston source vibrating in a large baffle. The source is the end of a magnetostrictive rod driven by an improved Pierce oscillator with a frequency range of 11.3 to 112 kilocycles. The microphone was built up from a single bend-type Rochelle salt bimorph element and is moved magnetically through the measuring chamber.

D. F. R.

Rugged quartz membrane manometers of small volume. C. Kenty (*Rev. Sci. Instr.*, 1940, 11, 377—386).—The manometers consist of clear fused quartz discs, plane polished, 0.1—0.5 mm. thick, and 0.5—2.5 cm. diameter, sealed on to fused quartz heads, either plane or slightly concave. Movement of the disc is measured by means of a three-legged rocker, the middle leg resting on the disc, in conjunction with a mirror or pointer and microscope, or by interference fringes set up between the disc and a nearby slightly concave quartz surface. The manometers are operable up to 800° and measure pressure >50 atm. ($\pm 0.1\%$). Vols. as small as 4 cu. mm., with resulting freedom from explosion hazard, have been attained.

D. F. R.

Bergman, Klaproth, Vauquelin, and Wollaston. E. G. Ferguson (*J. Chem. Educ.*, 1940, 17, 555—562).

L. S. T.

XIII.—GEOCHEMISTRY.

New method of measuring the mean height of the ozone in the atmosphere. J. Strong (*J. Franklin Inst.*, 1941, 231, 121—155).—The mean height of the O_3 in the atm. is determined by measuring the intensity of absorption of sunlight by three absorption bands: absorption in the ultra-violet by the Hartley band, to determine the total amount of O_3 overhead; absorption in the infra-red by the H_2O vapour band at 1.14μ , to determine the total amount of H_2O overhead; and the absorption at 9.6μ , which is due to both H_2O and O_3 . The ultra-violet absorption in the Hartley band is approx. independent of pressure, whereas the infra-red absorption by $O_3 \propto$ (total pressure)². Thus the ultra-violet and infra-red absorptions together determine the average total pressure on the O_3 , and hence the average height of the O_3 layer can be obtained. The val. obtained is ~ 25 km., which is rather $>$ vals. obtained by other methods. Possible sources of error are discussed. The new method has the advantage that determinations can be made at all positions of the sun.

A. J. M.

Calcium carbonate content of sea [water] with special reference to the Baltic Sea. K. Buch (*Finska Kem. Medd.*,

1940, 49, 64—87).—A crit. review of saturation conditions for CaCO_3 in the North Atlantic and Baltic Sea. An expression is given for deriving δ , the degree of super- or un-saturation (mg. equiv. of CaCO_3 per l. H_2O > or < saturation), from $[\text{Ca}^{++}]$, $[\text{Cl}^-]$, titration alkalinity, temp., and p_{H} of the corr. saturated solution. This last is calc. from p_{H} (obs.), $[\text{Cl}^-]$, and temp., and tables valid for various areas of the Baltic (to a depth of 20 m.) and graphs for deep H_2O in the Bornholm basin are given. Vals. of δ for the Atlantic between England and N. America and northwards from Iceland to the ice-limit are calc. From autumn to early summer the surface H_2O of the Baltic is unsaturated (with respect to CaCO_3) except in the extreme south, but becomes slightly supersaturated in summer, except in the extreme north of the gulf of Bothnia. The bottom H_2O is everywhere highly unsaturated at all seasons. Supersaturation in summer is due to growth of plankton, which raises the p_{H} , absence of nuclei preventing pptn. The surface layer is changed in autumn by convection but temp. has no direct influence on the saturation conditions. Vals. of δ for 81 sampling stations in the Baltic are given, in one case over a 9-years period. M. H. M. A.

Manganese slime carried off by the Kviril river. D. I. Eristavi (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 718—721).— H_2O taken at 5 points has been examined as to transparency, colour, p_{H} , sp. conductivity and wt. of suspended matter, rate of sedimentation, etc. The p_{H} varies from 7.5 to 7.8, showing a basic reaction both above and below the factories dressing Mn ores. The slime contains SiO_2 38, Mn 23, MnO 3, MnO_2 30, and Al_2O_3 10%, with oxides of Fe, Ti, Ca, Mg, Ba, Ni, Co, V, S, P. The sp. conductivity is $\sim 2.3 \times 10^{-4}$. T. H. G.

Present status of knowledge regarding the hydraulics of ground water. O. E. Meinzer and L. K. Wenzel (*Econ. Geol.*, 1940, 35, 915—941).—A review. L. S. T.

Geochemical complexes. A. E. Fersman (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 148—150).—Three types are described: the primary geochemical, the metamorphic geochemical, and the mobile equilibrium complex. O. D. S.

"Bolshaya Korta" meteorite. A. A. Onosovskaja (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 122—123).—Olivine, plagioclase with admixture of albite, troilite, and a nickeli-ferous Fe mineral have been identified in the meteorite. O. D. S.

Geology of Ardgor, Argyllshire. H. I. Drever (*Trans. Roy. Soc. Edin.*, 1940, 60, 141—170).—The distribution of the rock types and their field relationships, and the petrography of the rocks are described. Evidence of contact and regional metamorphism, and of contamination and metasomatism by acid magma, is discussed. Numerous chemical analyses are collected. L. S. T.

Field method for determining the magnetic susceptibility of rocks. R. C. Hyslop (*Amer. Inst. Min. Met. Eng.*, 1941, *Tech. Publ.* 1285, 4 pp.).—Curves obtained by means of the Schmidt vertical magnetometer are used to determine the magnetic susceptibility of rock specimens. L. S. T.

Determination of magnetic susceptibilities of rocks in situ. R. G. Paterson (*Amer. Inst. Min. Met. Eng.*, 1941, *Tech. Publ.* 1298, 9 pp.).—A method for determining susceptibilities of rocks or rock formations *in situ* by means of an a.c. bridge is described. Such vals. are preferable to those obtained on separate specimens. L. S. T.

Distribution of ammonites in the Lower Permian of the Urals and the resulting stratigraphic conclusions. S. V. Maximova and V. E. Rushentzev (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 160—163).—An analysis of the distribution of ammonites in the Lower Permian strata of the Urals indicates that the boundary between the Carboniferous and the Permian should be drawn at the base of the Sakmarian. O. D. S.

Axinite in the near-polar Urals. M. F. Beliakov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 158—159).—Axinites have been found associated with Lower Palaeozoic metamorphic shales in the Ural range. O. D. S.

Loparite-bearing horizon at the Lovozero tundras. I. V. Zelenkov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 151—152).—A loparite-bearing urtite horizon is described. O. D. S.

Geochemical peculiarities of the serpentinites of the north Caucasus. N. E. Efremov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 336—339).—Serpentinites from the southern zone of the north Caucasus, formed by metamorphisation of a mafic magma, contain ~ 4 —5% Al_2O_3 , which is not found in those of the northern zone, produced from an ultramafic magma. The excess of Al_2O_3 is contained in the serpentine constituent, and is associated with a "hydrargillite" terrace at 300° in thermal analysis data; this is found both with the serpentinites of the southern zone and with serpentine individuals (antigorite) obtained therefrom. L. J. J.

Classification of serpentine minerals by the method of thermal analysis. N. E. Efremov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 442—445).—The serpentines have been investigated by thermal analysis, and the results of other workers are discussed. An exothermal effect, the extent of which depends on the composition of the mineral, is observed. In colloidal varieties the exothermal effect is absent. A. J. M.

Titaniferous vesuvianite from the Perovskite and Akhmat mines, South Urals. V. S. Miasnikov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 446—449).—Analyses and physical properties are recorded. A. J. M.

Donbassites, a new group of minerals from the Donetz basin. E. K. Lazarenko (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 519—521).—Radial aggregates of a foliated mineral, previously mistaken for pyrophyllite, occur in the lode walls and crush zones of ore deposits and also on slickensides in coal and shale at several places in the Donetz basin, Ukraine. The pearly-white folia are flexible and have a perfect cleavage, d 2.628, H 2½, α 1.728, β 1.729, γ 1.735. Three analyses show SiO_2 33.64—34.73, Al_2O_3 45.02—48.08, H_2O 13.20—15.20%, with small amounts of Fe_2O_3 , MgO , CaO , Na_2O , Li_2O . The formulæ $\text{H}_{14}\text{Al}_8\text{Si}_6\text{O}_{29}$, $\text{H}_{18}\text{Al}_{10}\text{Si}_8\text{O}_{37}$, and $\text{H}_{16}\text{Al}_{10}\text{Si}_8\text{O}_{36}$ are based on the chloritoid nucleus $\text{H}_2\text{Al}_2\text{SiO}_6$ (margaritic acid of Vernadsky). Only 0.017% H_2O is lost at 450° . L. J. S.

Theory of mineral sequence in hypogene ore deposits. L. H. Hart (*Econ. Geol.*, 1940, 35, 1014—1018).—A discussion (cf. A., 1940, I, 379). L. S. T.

Spodumene pegmatites of N. Carolina. F. L. Hess (*Econ. Geol.*, 1940, 35, 942—966).—General geology, distribution, history, and economic features are described. Details of the main pegmatites and analyses of their alkali contents are given. L. S. T.

Origin of some pegmatites in Newry, Maine. B. M. Shaub (*Amer. Min.*, 1940, 25, 673—688).—Structural and textural characteristics of the minerals of certain pegmatites are described. The origin of the pegmatites is credited to a progressive fractionation of single injections of pegmatite magmas separated in time and space. L. S. T.

Diopside in Arizona. F. W. Galbraith and T. H. Kuhn (*Amer. Min.*, 1940, 25, 708—710).—Diopside occurs in quantity at the Mammoth Mine, Pinal County. L. S. T.

Geology of the Nighthawk Peninsular gold mine. A. R. Byers (*Econ. Geol.*, 1940, 35, 996—1011).—The ore bodies occur in or near a small stock of albite syenite, which is intrusive into andesite flows. They are carbonatised zones with disseminated pyrite (I) and arsenopyrite (II). (I) forms 90% of the metallic minerals, and (II), cobaltite, chalcopyrite, sphalerite, petzite, and Au occur in minor amounts. Gangue minerals are ankerite, and quartz with lesser sericite, fuchsite, and chlorite. Paragenesis and the origin of the deposit are discussed. L. S. T.

Cascade andesites of Oregon. R. Bogue and E. T. Hodge (*Amer. Min.*, 1940, 25, 627—665).—The rocks of the Cascan formation of the Cascade Mountains of Oregon are made up of lavas with a diverse mineral composition. The minerals olivine, hypersthene, enstatite, plagioclases, quartz, etc. are described, and chemical analyses [G. C. Ware] of 4 rocks are recorded. The rocks were derived apparently from a magma rich in SiO_2 , Na_2O , and Al_2O_3 with a composition analogous to that of dacite, and the complex mineral assemblages are best explained as a change from a dacitic magma to a basic andesite end product. Except for the plagioclases, the rocks did not follow the normal order of crystallisation. L. S. T.

Dehydration of pollucite. M. Fleischer and C. J. Ksanda (*Amer. Min.*, 1940, 25, 666—672).—Dehydration curves of

pollucite from Hebron, Maine, and from Elba are reproduced, and compared with the results of Strunz (A., 1937, I, 205). Dehydration commences at 300° and is complete at 640°. Microscopical and X-ray examinations of the dehydrated material show that the H₂O present in the mineral is not an essential part of the crystal lattice. The rotation powder photographs of the original and dehydrated samples are identical. The dehydrated material is partly rehydrated by heating to 400–500° with H₂O in a bomb, without the formation of clay-like alteration products. L. S. T.

Cæsium in the pegamites of the Kalbino granites of East Kazakhstan. S. A. Borovik and I. G. Tschentzov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 252–254).—By comparison of the intensities of the Cs 8521·15 and Ba 7911·35 Å. lines in the emission spectra, it has been shown that these rocks contain 0–0·4% of Cs. They also contain 0–0·5% of Rb and 0–6% of Li. J. W. S.

Molybdenite deposits of the Rencontre East Area, Newfoundland. D. E. White (*Econ. Geol.*, 1940, 35, 967–995).—In the Ackley City ore body, molybdenite is disseminated in altered aplite; a "honeycomb" of alteration patches has been formed by the mineralising solutions that penetrated the aplite. The origin of the aplite and the mineralisation are discussed. The Crow Cliff deposit is a pegmatite type. Chemical analyses [R. Folinsbee and R. B. Ellestad] of alaskite, apatites, muscovitised aplite, and molybdenite-apatite are recorded. L. S. T.

Magnetite deposits near Daltonganj, Palamanu district, with a note on electric smelting. K. K. Sen Gupta and J. Sen Gupta (*Quart. J. Geol. Soc. India*, 1939, 11, 143–148).—The magnetite occurs as the midrib of a range of hills at Gore village. Estimated reserves amount to 4×10^6 tons. Chemical analyses are given. Smelting in a blast furnace is unsatisfactory, and electric smelting is recommended. L. S. T.

Shishimskite (perovskite-spinel magnetite) from the Praskovie-Eugenievsky mine in the Shishim Mts., South Urals. L. L. Shilin (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 346–349).—This ore has typically the composition magnetite and hæmatite 72%, spinel 15%, perovskite 13%. Analyses are given and compared with common titaniferous magnetite. L. J. J.

Age of the phosphorite-bearing beds of the Kara-tau. P. L. Bezrukov, B. M. Himmelfarb, and A. S. Sokolov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 255–258).—From the forms of trilobites and brachiopods found in the lower portion of the Tamdy limestone overlying the phosphorite deposits in the Kara-tau, it is inferred that these deposits belong to the Middle Cambrian age. J. W. S.

Laboratory tests with the water-bearing capacity on trap and associated recent rocks in the Deccan and Konkan areas. D. G. Limaye (*Quart. J. Geol. Soc. India*, 1940, 12, 31–50).—Data for apparent and real sp. gr., H₂O content, porosity, accessible porosity, absorption of H₂O, H₂O eqvts., and yield of H₂O are recorded and discussed. L. S. T.

Zonal mineralisation and silicification in the Horseshoe and Sacramento districts, Colorado. R. D. Butler and Q. D. Singewald (*Econ. Geol.*, 1940, 35, 793–838).—Mineralisation includes widespread recrystallisation of the pre-Pennsylvanian dolomites, less widespread replacement of dolomite by jasperoid, and deposition of ore accompanied by additional local wall rock alteration. Field and microscopical observations concerning these processes are discussed. The ores contain mainly pyrite, sphalerite, galena, tennantite, and argentite in a gangue of quartz, barite, carbonate, and recryst. and silicified country rock. Manganiferous ankerite, luzonite, chalcopyrite, and an unidentified sulphide occur locally in small amounts. These minerals exhibit zonal distribution as to mineral species, textures, and variations in composition. The zonal arrangement of the three textural types of jasperoid distinguished is significant, and reveals the finest-grained textures nearest the centre of ore deposition. L. S. T.

Abundance and significance of cristobalite in bentonites and fuller's earths. J. W. Gruner (*Econ. Geol.*, 1940, 35, 867–875).—X-Ray examination shows the presence of α -cristobalite (I) in numerous bentonites and fuller's earths from Montana, Wyoming, Colorado, Texas, Missouri, and Illinois. (I) is always associated with montmorillonite, and may con-

stitute up to 40% of the clay. With a decrease in (I) an increase in quartz (II) occurs, indicating that the metastable (I) inverts to (II) at some time during the history of the clay. No (I) has so far been found in clays older than the Cretaceous. The presence of (I) appears to have no detrimental effect on the properties of fuller's earth. The origin of (I), which is uncertain, is discussed. L. S. T.

Time and temperature effects in the formation of colloidal dispersions. P. G. Nutting (*J. Washington Acad. Sci.*, 1941, 31, 41–45).—The behaviour of montmorillonite bentonite digested in 0·4% HCl at 28° and at 90° is described. The solutions obtained may contain > twice the amount of SiO₂ present in a saturated solution of SiO₂ in H₂O. At 90° equilibrium is approached in 4 days, but at 28° saturation is still incomplete after 128 days. Part of the R₂O₃ leaves the clay and combines with SiO₂ to form submicroscopic colloidal particles recoverable by evaporation. The bearing of these results on the formation of clay colloids in rock cavities and soils is discussed. L. S. T.

Occurrence of vanadium and molybdenum in clays. V. L. Bosazza (*Nature*, 1940, 146, 746).—Many fire and building bricks made from clays of Karroo age show a greenish- or canary-yellow efflorescence after weathering. The efflorescence is sol. in H₂O, and contains V and Mo. Mo is the rarer constituent, and is best detected by heating the clay to ~1000°, extracting with hot H₂O, and crystallising the salts from the solution. H₂O-sol. material from an under-fired brick contained MoO₃ 0·08, SO₃ 1·01, and CaO 0·28%. V, but not Mo, is easily detected spectrographically in raw clay. L. S. T.

Degree of dispersion of clays. IV. Shapes of clay particles. C. E. Marshall (*J. Physical Chem.*, 1941, 45, 81–93).—Observations of dityndallism combined with those of extinction directions and birefringence in flowing clay sols enable the shape of the suspended particles to be deduced. For several clay minerals particles >100 m μ . are platy and only slightly elongated. The determination of axial ratios is possible from sedimentation data and ultramicroscopical counts if the particles are regarded as flattened ellipsoids of rotation. In platy particles the larger axes lie approx. in the plane of the plates. In the birefringence experiments the Langmuir tilting effect was always observed. Only when the angle of tilt is small does dityndallism give a satisfactory indication of particle shape. C. R. H.

Utilisation of different methods of peptising clays for the study of the mineralogical composition of their colloidal fractions. I. N. Antipov-Karataev, I. D. Sedletzki, and S. M. Jusupova (*Kolloid. Shurn.*, 1940, 6, 133–144).—15 samples of various Turkestan clays were separated into fractions: (I) having particles between 2 and 0·2 μ ., (II) with particles <0·2 μ ., (III) with particles <2 μ ., which could be peptised by N-NaCl, and (IV) with particles <2 μ ., which could not be peptised by N-NaCl. There is little difference between fractions (III) and (IV). (I) have higher ratios SiO₂:Al₂O₃ than (II). X-Ray patterns indicate a different mineralogical composition of (I) and (II), e.g., halloysite and quartz in (I) and montmorillonite in (II), or quartz and nacrite in (I) and muscovite and saponite in (II). The results of thermal analysis are less clear. J. J. B.

Granulometric composition of sands as an index of the conditions of their deposition. L. B. Ruchin (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 522–524).—Sands deposited under different conditions can be distinguished. Errors involved in the method are indicated.

Genesis of setting loess-like loams. N. J. Denisov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 525–526).

Coral reefs and the formation of petroleum. W. Bergmann and D. Lester (*Science*, 1940, 92, 452–453).—Coral reefs must be regarded as storehouses of compounds which may be potential precursors of petroleum. COMe₂ extracts of stag-horn coral (*Madrepora cervicornis*) yield cetyl palmitate (0·25% of the original coral). The non-saponifiable fraction (0·25% of the total) yielded sterols pptd. by digitonin, non-steroid alcohols [mainly cetyl alcohol (I)], and hydrocarbons and ketones. *Meandrea areolata* contains ~0·3% of non-saponifiable material consisting of cholesterol, an unknown sterol, (I), hydrocarbons, and possibly ketones. The calcareous outside layers of the sea-fans contain ~3% of non-saponifiable material. L. S. T.

JUNE, 1941.

I.—SUB-ATOMICS.

Proposed standard solar-radiation curves for engineering use. P. Moon (*J. Franklin Inst.*, 1940, 230, 583—617).—Data obtained by various workers on solar radiation are correlated, and a standard spectral distribution curve for sunlight outside the atm. is given. Methods are described which enable results to be corr. for elevation and air mass.

A. J. M.

Determination of $1/\lambda_2 - 1/\lambda_1$ for the D_1, D_2 lines of sodium. G. F. C. Searle (*Proc. Physical Soc.*, 1941, 53, 265—271).—The method depends on adjusting a plate and lens for the coincidence of the Newton rings due to D_1 -light with either the rings due to D_2 -light or the dark spaces between those rings. The val. found for $1/\lambda_2 - 1/\lambda_1$ is 17.434 cm^{-1} compared with 17.19 deduced from the standard vals. of λ_1 and λ_2 .

N. M. B.

Term values in V II and Mn II. D. S. Bowman (*Physical Rev.*, 1941, [ii], 59, 386—388).—Calc. term vals. for d^2s and d^5s in Russell-Saunders coupling are tabulated. Theoretical formulæ including Ostrofsky's results for d^4 (cf. A., 1934, 1285) are then applied to the observed vals. for V II and Mn II.

N. M. B.

Reflecting-power measurements in the spectral region 2000—1300 Å. B. K. Johnson (*Proc. Physical Soc.*, 1941, 53, 258—264).—Reflexions % of Al, Cr, Si, speculum, Ag, Pt, glass, fused quartz, and LiF have been measured at 7 different λ 's by means of a special apparatus, and are tabulated.

N. M. B.

L-Emission bands of sodium, magnesium, and aluminium. W. M. Cady and D. G. Tomboulion (*Physical Rev.*, 1941, [ii], 59, 381—385).—A spectrophotometric study of the radiation band emitted when conduction electrons fill vacancies in the L shell is reported. The band shape represents the energy distribution of the conduction electrons, and observed shapes are in general agreement with theory and confirm available experimental data (cf. O'Bryan, A., 1934, 577). In each case a "tail" is observed at the low-frequency end of the band, and explanations are proposed. With the X-ray continuum as a standard of intensity, the total intensity of the L band increases 19-fold from Na to Al.

N. M. B.

Breakdown potentials of gases under alternating voltages. G. W. Fox and D. O. McCoy (*J. Appl. Physics*, 1940, 11, 592—595).—The breakdown potentials of N_2 , H_2 , He, and A of commercial purity have been investigated with varying pressures and gap distances (10—50 mm.) and for frequencies up to 10^6 cycles per sec. A discharge tube with spherical electrodes was used. Curves of log pressure against log gap distance are drawn for each gas and each frequency. The slope of this curve is independent of frequency, and also of the gas used if the gap distance is small.

A. J. M.

Extraction of electrons from cold metals at high field-strengths. W. Jackson and A. E. Chester (*J. Inst. Electr. Eng.*, 1941, 88, Part I, 149—160).—The experimental technique of the investigation of field emission from cold metals is described. It is concluded that the Fowler-Nordheim theory is substantially correct in giving, for pure metals, the dependence of field emission on field strength and on temp. It also explains adequately the energy distribution of the electrons involved. The modification of the Fowler-Nordheim theory to take into account the effect of surface films is shown to be in agreement with experiment. Breakdown phenomena and total-voltage effects are discussed. Beams' work on the Hg cathode is considered. The field emission of thin films, such as oxide films, is also discussed. A bibliography is given.

A. J. M.

185 F (A., I.)

Scattering of fast electrons by heavy elements. II. J. H. Bartlett, jun., and T. A. Welton (*Physical Rev.*, 1941, [ii], 59, 281—290; cf. A., 1939, I, 594).—Mathematical. The modification of scattering, due to extranuclear electrons, when fast electrons impinge on a Hg atom is calc. Scattering as a function of angle is determined for 100- and 230-kv. electrons. Phase shifts are determined by three different methods. Results are compared and discussed.

N. M. B.

Secondary electron emission from metals. A. E. Kadischewitsch (*J. Physics U.S.S.R.*, 1940, 2, 115—129).—Mathematical. The mechanism of secondary electron emission from metals is discussed, and it is shown that its intensity (I) depends on the ratio (r) of the path of a primary electron before its velocity becomes low to the free path of the secondary electron. With increasing energy of the incident electrons, i.e., with increasing r , I increases until $r = 0.56$, after which it decreases. The course of the calc. I - r curve is in accord with observation. The variation of I with the angle of incidence of the primary electrons, and the velocity and directional distribution of the secondary electrons, are also deduced.

J. W. S.

Distribution function for electrons in a metal in a strong magnetic field. V. A. Dmitriev (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 601—603).—Mathematical. W. R. A.

Contraction of plasma in a magnetic field. E. M. Reichrudel and G. V. Spivak (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 609—613).—The contraction of plasma produced by a magnetic field has been measured in A and Hg vapour using (a) a flat anode which was capable of vertical and horizontal movement, and (b) an anode of the concentric-type. In both methods the anode c.d. served as a measure of the relative electron concn. at a given point in the plasma and the experimental data from both methods agree.

W. R. A.

Ionisation maximum for protons. N. Feather (*Nature*, 1941, 147, 510—511).—A crit. discussion of the conclusions of Holloway and Moore (A., 1941, I, 142). Evidence that the max. sp. ionisation is $\frac{1}{2}$ one half, rather than one third, of the max. sp. ionisation due to an α -particle is quoted.

L. S. T.

Probability of formation of pairs in gases by γ -rays. L. V. Groschev (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 448—450).—The effective cross-section (s) of Xe for electron-pair production by γ -rays from Th-C'', derived from Wilson chamber measurements, is $5.8 \times 10^{-25} \text{ sq. cm}$. This val. is compared with data for Kr and N_2 (cf. A., 1940, I, 306). In each case s is $<$ the val. calc. from Born's approximation; Jaeger and Hulme's formula (A., 1936, 400) gives an approx. const. ratio ($= 2$) of calc. to observed s vals., showing that this formula gives the correct dependence of s on Z .

A. J. E. W.

Angular distribution for electron-positron pairs in gases. L. V. Groschev (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 451—453; cf. A., 1940, I, 307).—The distribution of the following angles has been studied from a statistically adequate no. of Wilson chamber measurements of pair production by Th-C'' γ -rays in N_2 , Kr, and Xe: angles between the tracks of photon and positron (χ), photon and electron (ψ), and positron and electron (ϕ); the angle (α) between the photon track and the plane of the pair; the dihedral angle (Φ) between planes passing through the photon and the positron and electron tracks, respectively. The mean vals. of χ , ψ , and ϕ increase approx. linearly with Z ; contrary to Born's approximation, the mean χ and ψ vals. are equal only in N_2 . The Φ distributions are similar, large vals. being favoured. Small α vals. are strongly preferred. The results are in qual. agree-

186

ment with Jaeger and Hulme's calculations (A., 1938, I, 591).

Relative abundance of oxygen isotopes. B. F. Murphy (*Physical Rev.*, 1941, [ii], 59, 320; cf. Smythe, A., 1934, 469).—With a 60° mass spectrometer, the ratio found for a large no. of determinations on air and commercial O_2 is $^{16}O/^{18}O = 500 \pm 15$, and, from a complete mass spectrum of the 33 peak corr. for background, $^{18}O/^{17}O = 4.9 \pm 0.2$. Hence the physical-chemical mass scale conversion factor is 1.000275 ± 0.000009 . N. M. B.

Energy of neutrons from the deuteron-deuterium reaction. T. W. Bonner (*Physical Rev.*, 1941, [ii], 59, 237—240; cf. A., 1939, I, 397).—A precision determination gives the val. 3.58 ± 0.03 Me.v. for the energy of the neutrons emitted in the forward direction to the 0.52-Me.v. deuterons which produce the disintegrations. $Q = 3.31 \pm 0.03$ Me.v. and hence the calc. mass of 3He is 3.01698 ± 0.00006 mass units. N. M. B.

Slow neutron velocity spectrometer. C. P. Baker and R. F. Bacher (*Physical Rev.*, 1941, [ii], 59, 332—348).—Neutron bursts were produced by modulation of the arc source of a small cyclotron. Neutrons slowed in paraffin were detected by a BF_3 ionisation chamber and linear amplifier with discriminating amplifier and modulator circuit. Thin Cd showed a resolved resonance absorption with max. at 0.14 e.v. For thick Cd the absorption edge was not sharp, the transmission being 0.5 at 0.47 e.v. Thick Rh and In absorbers showed resonance absorption at 1.0 e.v. A study of delayed emission of thermal neutrons from the paraffin surrounding the source showed an effective mean life of 170 μ -sec. From the thin Cd absorption curve the total width Γ of the resonance level was 0.12 e.v., and from the cross-section at resonance $[1 \pm (1/2i + 1)]\Gamma_n$, where Γ_n is the neutron width and i is the angular momentum of the absorbing nucleus, the val. was 5×10^{-4} e.v. N. M. B.

Capture cross-section for thermal neutrons of Cd, ^{11}B , Ba, Hg, and 1H . E. L. Harrington and J. L. Stewart (*Canad. J. Res.*, 1941, 19, A, 33—41).—A comparison method for the determination of capture cross-sections for thermal neutrons by working with aq. solutions is described. Assuming the val. 2600×10^{-24} sq. cm. for Cd, the following vals. have been obtained: ^{11}B , 2760×10^{-24} ; ^{11}Li , 846×10^{-24} ; Hg, 323×10^{-24} ; Ba, $< 21.4 \times 10^{-24}$, and 1H , 0.464×10^{-24} sq. cm. The vals. for Ba and H differ widely from those found by other workers. F. J. G.

Nomenclature of nuclear particles. C. Moller (*Physical Rev.*, 1941, [ii], 59, 323; cf. A., 1941, I, 70).—The term nucleon, instead of nucleon, is proposed for heavy nuclear constituents, neutrons and protons. N. M. B.

β -Ray spectra of light elements. A. A. Townsend (*Proc. Roy. Soc.*, 1941, A, 177, 357—366).—A magnetic spectrometer, which is described, was used to investigate the β -ray spectra of some artificial radioactive elements. All the spectra follow the Fermi distribution law for a certain range near the high-energy end-point. The half-life periods (in parentheses) and end-points in Me.v. are: for ^{11}C (20.6 min.) 0.981 ± 0.005 , for ^{13}N (9.95 min.) 1.218 ± 0.004 , for ^{15}O (2.55 hr.) 2.88 ± 0.01 and 1.035 ± 0.015 , for ^{64}Cu (10.6 hr.) positrons 0.649 ± 0.004 and negatrons 0.574 ± 0.004 , for ^{63}Zn (39 min.) 2.320 ± 0.005 . G. D. P.

Disintegration of boron by slow neutrons. R. S. Wilson (*Proc. Roy. Soc.*, 1941, A, 177, 382—392).—The disintegration was studied by means of an ionisation chamber filled with BCl_3 . Two disintegration energies were observed. The greater of these is assumed to correspond with the formation of the 7Li nucleus in the ground state; the smaller, which is released in about 93% of the disintegrations, is due to the formation of 7Li in an excited state of approx. 0.4 Me.v. The γ -radiation associated with the return of the excited 7Li to the ground state was detected and its quantum energy roughly measured. G. D. P.

Application of a pressure electrostatic generator to the transmutation of light elements by protons. T. Lauritsen, C. C. Lauritsen, and W. A. Fowler (*Physical Rev.*, 1941, [iii], 59, 241—252).—The design and performance of a large generator capable of operating at 1.7 M.v. under 80 lb. per sq. in. are discussed. Studies of γ -radiation produced in the transformation of ^{19}F , ^{15}N , and ^{13}C by protons are reported. N. M. B.

Transmutation of fluorine by protons. J. F. Streib, W. A. Fowler, and C. C. Lauritsen (*Physical Rev.*, 1941, [ii], 59, 253—270).—The excitation functions for the production of long-range α -particles, γ -rays, and electron pairs by the bombardment of ^{19}F by protons up to 1.5 Me.v. energy are observed simultaneously. The long-range α and pair curves show resonance peaks superimposed on a background of increasing intensity with increasing bombarding energy. There is evidence that full- and short-range α -particles preceding pair emission can be products of competing modes of decay of the same intermediate states of ^{20}Ne . This suggests that the state of ^{16}O which decays by pair emission has the same parity (even) as the ground states of ^{16}O and thus that the pair emission can be due to ordinary electromagnetic forces. Abs. yields of the various processes are measured, and the measurement of high-energy γ -ray and pair yields by electroscopes is discussed. N. M. B.

Long-lived radioactive carbon, ^{14}C . S. Ruben and M. D. Kamen (*Physical Rev.*, 1941, [ii], 59, 349—354).— ^{14}C was produced by deuteron bombardment of graphite and by slow-neutron irradiation of N compounds (NH_4NO_3 , NH_4NO_2 , etc.). The radiations consist of low-energy negative electrons of range 19 ± 2 mg. per sq. cm. of Al (145 ± 15 ke.v. upper energy limit). No soft or hard γ -rays were detected. The reactions must be $^{13}C(d, p)^{14}C$ and $^{14}N(n, p)^{14}C$. No decay over 9 months was shown. Cross-section and yield estimates indicate a half-life of 10^3 — 10^6 years. The production, isolation, and detection of ^{14}C for tracer work is described. N. M. B.

Protons from the deuteron bombardment of the separated isotopes of chlorine. E. F. Shrader and E. Pollard (*Physical Rev.*, 1941, [ii], 59, 277—280; cf. A., 1940, I, 339).—By bombarding with 3.2-Me.v. deuterons targets in which the proportion of ^{37}Cl had been increased by $> 100\%$, Q vals. of groups of protons were assigned as follows: $^{35}Cl(d, p)^{36}Cl$ 6.31, 5.35, and 1.50 Me.v., $^{37}Cl(d, p)^{38}Cl$ 4.02, 3.02, and 2.10 Me.v., leading to isotopic masses ^{36}Cl 35.9808 and ^{38}Cl 37.9806. A group of α -particles at 12 cm. range is assigned to ^{35}Cl according to the reaction $^{35}Cl(d, \alpha)^{33}S$; the Q val. is 9.1 Me.v., giving $^{33}S = 32.9828$ in good agreement with 32.9826 from the $^{32}S(d, p)^{33}S$ reaction. N. M. B.

Mechanism of chemical reactions accompanying the isomeric radioactive transition of ^{80}Br . J. E. Willard (*J. Amer. Chem. Soc.*, 1940, 62, 3161—3165).—In the gas phase the isomeric radioactive transition $^{80}Br^*$ (4.4 hr.) \rightarrow $^{80}Br^*$ (18 min.) results in $< 2\%$ reaction of ^{80}Br (18 min.) with CCl_4 , whereas in the liquid and solid phases 30% and 12% reaction occurred, respectively. In the condensed phases free radicals are thought to be formed by different mechanisms and they react with $^{80}Br^*$ (18 min.). The production of $^{80}Br^*$ (18 min.) from $^{80}Br^*$ (4.4 hr.) in chemical reactions may take place in three ways: (a) decomp. reactions, e.g., $Et^{80}Br$ (4.4 hr.) \rightarrow $Et^{80}Br$ (18 min.) $^+$ + ϵ , $Et^{80}Br$ (18 min.) $^+$ \rightarrow Et + ^{80}Br (18 min.) $^+$; (b) addition reaction in which ^{80}Br (18 min.) $^+$ ions acquire an electron and then combine with a free radical, e.g., CCl_4 + ^{80}Br (18 min.) $^+$ + $\epsilon \rightarrow CCl_3$ + ^{80}Br (18 min.) + Cl , followed by CCl_3 + ^{80}Br (18 min.) $^+$ \rightarrow $CCl_3^{80}Br$ (18 min.); (c) similar to (b) but involving combination with a normal mol. and not with a radical, e.g., ^{80}Br (18 min.) + $C_2H_2 \rightarrow C_2H_2^{80}Br$ (18 min.), followed by $C_2H_2^{80}Br$ (18 min.) + $HBr \rightarrow C_2H_3^{80}Br$ (18 min.) + Br . At least 90% of the isomeric ^{80}Br transitions are accompanied by emission of a conversion electron rather than by γ -radiation. W. R. A.

Deuteron bombardment of gold. R. S. Krishnan (*Proc. Camb. Phil. Soc.*, 1941, 37, 186—193).—The bombardment of Au with 9.1-Me.v. deuterons gives rise to the formation of 2.7-day ^{198}Au by a ($d-p$) process, and of 32-hr. ^{198}Hg in a metastable state by a ($d-n$) process. The energies of the β - and γ -rays emitted by these nuclei have been obtained. The excitation functions for the two reactions have been determined and are discussed. No evidence is obtained for the occurrence of any reaction involving the simultaneous ejection of two particles, and the formation of a 19-hr. Ir isotope (Cork et al., A., 1938, I, 548) could not be detected. A. J. M.

Radioactive isotopes of germanium. G. T. Seaborg, J. J. Livingood, and G. Friedlander (*Physical Rev.*, 1941, [ii], 59, 320—321; cf. Sagane, A., 1939, I, 172).—Bombardment of Ga with 8-Me.v. deuterons produced a 40 ± 2 -hr. positron emitter and an 11-day activity due to ^{68}Ge or ^{70}Ge from the

$d, 2n$ reaction from ^{69}Ga and ^{71}Ga . Ge bombarded with 16-Me.v. deuterons gave the same periods assigned to the reaction $^{70}\text{Ge}(d, p)^{71}\text{Ge}$. Ge (40 hr.) emits 1.2-Me.v. positrons, and Ge (11 days) emits particles of ~ 0.6 Me.v. energy, and no γ -rays. Bombardment of Ge with 16-Me.v. deuterons gave a 90-min. activity, and As bombarded with fast neutrons gave a Ge fraction (89 ± 2 min.) attributed to $^{76}\text{As}(n, p)^{76}\text{Ge}$. Fast-neutron bombardment of Ge and Se gave a 90-min. period attributed to $^{76}\text{Ge}(n, 2n)^{75}\text{Ge}$ and $^{78}\text{Ge}(n, \alpha)^{75}\text{Ge}$. ^{76}Ge (89 min.) gave β -particles of max. energy 1.2 ± 0.1 Me.v. The product ^{77}Ge (12 hr.) is confirmed to arise from the d, p reaction in the bombardment of Ge with 16-Me.v. deuterons, and by the n, α reaction in the fast-neutron bombardment of Se. ^{69}Ge (29 min.), reported by Sagane, was not found.

N. M. B.

Radioactive isotope of protoactinium. G. T. Seaborg, J. W. Gofman, and J. W. Kennedy (*Physical Rev.*, 1941, [ii], 59, 321).—Experiments described confirm that the 25-day activity due to slow-neutron bombardment of Th is ^{233}Pa and not a Zr isotope. U chemically separated from the decay of ^{233}Pa was inactive with respect to β -particle emission.

N. M. B.

Radioactive ^{41}Sc , ^{35}A , and ^{31}S . D. R. Elliott and L. D. P. King (*Physical Rev.*, 1941, [ii], 59, 403; cf. A., 1941, I, 143).—Half-lives (sec.) and max. energy of emitted positrons (Me.v.), respectively, are: Sc 0.87 ± 0.03 , 4.94 ± 0.07 ; A 1.88 ± 0.04 , 4.41 ± 0.09 ; S 3.18 ± 0.04 , 3.87 ± 0.15 , in good agreement with results of White *et al.* (cf. *ibid.*, 94) except in the case of the A half life.

N. M. B.

Radioactive isotopes of osmium. G. T. Seaborg and G. Friedlander (*Physical Rev.*, 1941, [ii], 59, 400).—Os bombarded with slow neutrons from a cyclotron gives activities of periods 32 ± 2 hr. and 17 ± 1 days; the upper energy limits of the β -particles are 1.5 and 0.35 Me.v., respectively. Bombardment of Os with fast neutrons gives a weaker production of both activities, but the ratio of 32-hr. to 17-day activity is twice as large with the fast as with the slow neutrons. The provisional assignments are ^{191}Os (32 hr.) and ^{193}Os (17 days).

N. M. B.

Radiation properties of heavy nuclei. V. F. Weisskopf (*Physical Rev.*, 1941, [ii], 59, 318—319; cf. A., 1940, I, 187).—Mathematical. A provisional method of estimating the order of magnitude of radiative transition probabilities between nuclear levels of heavy nuclei is deduced. Results agree with available data.

N. M. B.

Radiative transition probabilities in heavy nuclei. Excitation of nuclei by X-rays. E. Guth (*Physical Rev.*, 1941, [ii], 59, 325—331).—Mathematical. From experimental absorption cross-sections for excitation of nuclei (^{115}In and Pb) by X-rays (cf. Waldman, A., 1940, I, 190), radiation widths, i.e., emission probabilities, are deduced; they are of the same order as those of the low levels of the natural radioactive nuclei. Formulae for the transition probabilities, depending on both energy and spin, are given. A simple expression, valid near the short- λ limit, for the intensity of X-rays produced by fast electrons is given. Doppler effect and self-absorption are considered.

N. M. B.

Velocity-range relation for fission fragments. N. Bohr (*Physical Rev.*, 1941, [ii], 59, 270—275).—A development of previous considerations (cf. A., 1941, I, 3). In estimating the effect of electronic interactions a comparison with the stopping of α -particles of the same velocities is used. In contrast to α -rays, fission-fragment tracks show, in agreement with calc. data, considerable range straggling at the end part of the range.

N. M. B.

Range and straggling of fission fragments. J. K. Bøggild, K. J. Brostrom, and T. Lauritsen (*Physical Rev.*, 1941, [ii], 59, 275—277; cf. A., 1941, I, 144).—Evidence of two groups of fission-fragment tracks corresponding with two types of fragments is supported by bombarding thin evaporated U layers on mica foils with slow neutrons in a cloud chamber. Histograms of ranges and sums of ranges of paired fragment tracks, relative to ranges of α -particles of similar velocities, show mean ranges of 19 and 25 mm. in A and 23 and 30 mm. in He for the two groups. The relatively lower stopping power of He is probably due to a smaller rate of velocity loss towards the end of the range for fragments than for α -particles, with relatively greater straggling (cf. preceding abstract).

N. M. B.

Fission products of uranium by fast neutrons. Y. Nishina, T. Yasaki, K. Kimura, and M. Ikawa (*Physical Rev.*, 1941, [ii], 59, 323—324; cf. A., 1941, I, 3).—From purified U_3O_8 , bombarded for ~ 12 hr. by fast neutrons, Rh (34 hr.) and Ru (~ 4 and ~ 60 hr.) were separated. Rh (34 hr.) is an electron emitter giving β -rays of max. energy 0.5 Me.v., and the decay product is probably a stable Pd isotope.

N. M. B.

β -Ray spectrum of $^{233}\text{ekatantalum}$. E. Haggstrom (*Physical Rev.*, 1941, [ii], 59, 322; cf. following abstract).—A preliminary description of the complex spectrum which consists mainly of conversion lines. The end-point is ~ 230 ke.v.

N. M. B.

Fourth ($4n + 1$) radioactive series. A. V. Grosse, E. T. Booth, and J. R. Dunning (*Physical Rev.*, 1941, [ii], 59, 322—323).—Experiments show that ^{230}Th is not identical with ^{230}U . Th captures neutrons by a strong resonance process above the Cd cut-off at < 25 e.v. energy. A search for ^{231}A ($2-3$ min.) by irradiating Th with neutrons was unsuccessful, but slow neutrons gave a β -emitting product ^{231}Et (27.4 ± 0.4 days) (cf. preceding abstract). Decay curves are shown, and quant. separation from Zr proves that it is not a Zr isotope.

N. M. B.

Report of cosmic ray observations made on the U.S. Antarctic Expedition in co-operation with the Bartol Research Foundation. S. A. Korff and E. T. Clarke (*J. Franklin Inst.*, 1940, 230, 567—581).—The investigation of the latitude effect for cosmic rays, carried out on the above expedition, is reported. Geiger counter observations indicate that there is a definite "knee" in the cosmic-ray intensity curve at about geomagnetic latitude 39° S. Between this latitude and the equator a drop of 8% occurs, and between 39° and 77° S. a variation of $3 \pm 0.3\%$ is found. Comparable results were obtained with a Millikan electroscop. The application of an external temp. coeff. of -0.15% per 1° C. makes the curve horizontal south of 39° . 154 bursts were recorded during 43 days of operation, and were classified according to size. The results suggest a latitude effect for the bursts of the same order as that for the total intensity. The sp. ionisation does not vary with latitude, so that the ratio of electrons to mesotrons is const. at all latitudes south of 39° .

A. J. M.

Multiplicative showers. M. Schönberg (*Ann. Acad. Brasil. Sci.*, 1940, 12, 281—299).—A discussion of the deviation from the observed data of the theories of Bhabha and Heitler and of Carlson and Oppenheimer.

F. R. G.

Variation of the rate of decay of mesotrons with momentum. B. Rossi and D. B. Hall (*Physical Rev.*, 1941, [ii], 59, 223—228; cf. A., 1940, I, 190).—Investigations of mesotrons of range 196—311 and also > 311 g. per sq. cm. of Pb show that the softer group disintegrate ~ 3 times as fast as the more penetrating group, in agreement with theory based on relativity. From measurements on particles of momentum $\sim 5 \times 10^8$ e.v./c the new val. of the proper lifetime of mesotrons is $(2.4 \pm 0.3) \times 10^{-6}$ sec.

N. M. B.

Scattering of mesotrons in tungsten. F. L. Code (*Physical Rev.*, 1941, [ii], 59, 229—232).—With a 30-cm. counter-controlled cloud chamber in a 12,900-oersted magnetic field, measurements of scattering angle θ and curvature for 359 tracks gave $\bar{E}\theta = 0-13.7 \times 10^9$ e.v. degrees for $\theta = 0-18.7^\circ$ and mean energies $\bar{E} < 2 \times 10^9$ e.v. There were also 92 high-energy tracks with a deflexion too small to be measured. Results confirm Williams' prediction of a Gaussian distribution of multiple scattering (cf. A., 1939, I, 291), and observed anomalous large-angle scattering supports theory as regards nuclear forces. The calc. mean multiple electrical scattering is 2.2×10^9 e.v. degrees compared with the experimental val. 2.14×10^9 . This agreement supports the assumption that the main force responsible for the Gaussian part of the scattering is that arising from the electric charges of the mesotron and nucleus.

N. M. B.

Correlation between cosmic-ray intensity at Cheltenham [U.S.A.] and the air temperatures and pressures for 1939. N. F. Beardsley (*Physical Rev.*, 1941, [ii], 59, 233—237; cf. A., 1940, I, 188).—Data show that the variation of cosmic-ray intensity depends 15% on total air pressure, 40% on the distribution of the air mass as correlated with the surface temp., 10% on world-wide changes, and 30% unaccounted for.

N. M. B.

Change in height of a mesotron-producing layer of air. N. F. Beardsley (*Physical Rev.*, 1941, [ii], 59, 402).—Mathematical. An application of Blackett's theory (cf. A., 1939, I, 55) to experimental data (cf. preceding abstract). Results indicate that Blackett's assumption of a decaying mesotron formed at a height which changes from day to day is a possible explanation for some observed variations in cosmic-ray intensity at the surface. N. M. B.

Cosmic rays at a depth equivalent to 1400 metres of water. Y. Nishina, Y. Sekido, Y. Miyazaki, and T. Masuda (*Physical Rev.*, 1941, [ii], 59, 401; cf. Barnóthy, A., 1939, I, 351).—Coincidence counter measurements indicate the existence of a high proportion of hard showers and the absence of non-ionising primary rays, although evidence as to whether the primaries for the hard showers are ionising or non-ionising particles is inconclusive. N. M. B.

Intensities of radiofrequency spectra. H. C. Torrey (*Physical Rev.*, 1941, [ii], 59, 293—299).—Mathematical. Theoretical and observed line shapes are compared by taking account of the inhomogeneity in velocity of the beam mols. N. M. B.

Self-consistent field calculations for (A) Zn, Ga, Ga⁺, Ga⁺⁺, As, As⁺, As⁺⁺, As⁺⁺⁺, (B) Ge⁺⁺ and Ge. W. Hartree, D. R. Hartree, and M. F. Manning (*Physical Rev.*, 1941, [ii], 59, 299—305, 306—307).—Full data with tables of wave functions and effective nuclear charges are reported. N. M. B.

Phase series. E. J. Hellund (*Physical Rev.*, 1941, [iii], 59, 395—399).—Mathematical. An expansion theorem for the calculation of the parameters occurring in the scattering cross-sections is developed. The series converges exponentially and is expressible in terms of known functions, provided the interactions are expressed as a power series in r and $1/r$. N. M. B.

Coulomb exchange energy in light nuclei. M. Phillips and E. Feenberg (*Physical Rev.*, 1941, [ii], 59, 400).—Isobaric mass differences reported by Haxby *et al.* (cf. A., 1941, I, 68) and Fowler *et al.* (cf. A., 1936, 659) find a simple qual. explanation in the periodic variation of the Coulomb exchange energy as calc. in the Hartree approximation (cf. A., 1937, I, 109, 278). N. M. B.

Exchange effects in the theory of the continuous absorption of light. I. Ca and Ca⁺. D. R. Bates and H. S. W. Massey (*Proc. Roy. Soc.*, 1941, A, 177, 329—340).—A theoretical investigation including the effect of electron exchange which appreciably modifies the results, particularly in the case of Ca⁺ and of K. A discrepancy between Strömberg's and Struve's independent determinations of the interstellar electron density is removed. G. D. P.

Polarisation of electrons by double scattering. H. S. W. Massey and C. B. O. Mohr (*Proc. Roy. Soc.*, 1941, A, 177, 341—357).—The scattering of electrons by Au, Xe, and Kr has been investigated using Dirac's equations. The polarisation to be expected by double scattering at 90° has been studied in the energy range 100—150,000 e.v. At energies for which the intensity of single scattering at 90° is near a min. a large polarisation is to be expected for Au. For Xe and Kr the polarisation is never >4% and 2% respectively. Modifications of the interaction between nucleus and electron which would reduce polarisation are considered. The polarisation resulting from double scattering by a potential well is investigated in detail. G. D. P.

Relation between ionic radii, atomic and quantum numbers, and valency. S. T. Li and C. E. Sun (*J. Chinese Chem. Soc.*, 1940, 7, 73—75).—Ionic radii of common elements are calc. from the expression $0.42Z^{-1/3}n^3$, in which Z is the at. no., z the valency, and n the principal quantum no. For Li to F inclusive n^3 is replaced by n^2 . The calc. vals. are tabulated with those of other authors. F. L. U.

II.—MOLECULAR STRUCTURE.

Electronic transitions of the BH molecule. A. E. Douglas (*Canad. J. Res.*, 1941, 19, A, 27—31).—A discharge in He containing traces of BCl₃ and H₂ shows bands at 3415, 3396, and 3099 Å., due to two previously unobserved electronic transitions of the BH mol. from new $^1\Sigma^+$ upper states c and d to the known $^1\Pi$ state b . The rotational consts. are evaluated and an electron configuration of the BH mol. is suggested. With

the two new $^1\Sigma^+$ states there are now six known electronic states of BH and these are completely analogous to the six known states of AlH. J. W. S.

(0, 3) Band of the first negative system of O₂⁺. T. E. Nevin and T. Murphy (*Proc. Roy. Irish Acad.*, 1941, A, 46, 169—181; cf. A., 1940, I, 183).—The λ 7348 (0 → 3) band of this system, which is due to the transition $\Sigma_g^- \rightarrow ^2\Pi_u$, was developed in a hollow-cathode discharge and photographed in dispersion 1.25 Å. per mm. Rotational analysis data are tabulated, and consts. of the final level $v'' = 3$ are calc. N. M. B.

Excitation of light emission from quartz under impact with canal rays of hydrogen and nitrogen. V. T. Chiplonkar (*Current Sci.*, 1941, 10, 19—21).—Canal rays of H and N of energies between 4 and 12 kv. excite light emission from quartz. With both exciting sources three groups of lines at 2870, 2150, and 2210 Å., belonging to either Si or O or both, are observed. The intensity distribution of the H continuum shows max. at 4000 and 3200 Å. and a shallow min. at ~3600 Å. but when fluorescence from the quartz window is eliminated only the max. at 4000 Å. is observable and that very faintly. Quartz does not emit a continuum. W. R. A.

Vibrational frequencies of polyatomic molecules. M. Elia-shevitch (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 604—608).—Mathematical. A general method of obtaining the equations of motion in vector form for calculation of vibrational frequencies. W. R. A.

Ultra-violet absorption spectra of organic molecules. Dependence on restricted rotation and resonance. M. T. O'Shaughnessy and W. H. Rodebush (*J. Amer. Chem. Soc.*, 1940, 62, 2906—2911).—The ultra-violet absorption spectra of 21 mols. containing aromatic rings have been examined and can be interpreted in terms of Mulliken's theories. The absorption spectra can serve as a criterion for restricted rotation in Ph₂ derivatives and similar mols. in which coplanarity is necessary for resonance. W. R. A.

Absorption spectrum of squalene. Z. Nakamiya and K. Koizumi (*Bull. Inst. Phys. Chem. Res. Japan*, 1941, 20, 141—149).—Squalene (I) has no special absorption max. Absorption bands of crude samples were removed by purification using acid clay as adsorbent. The low-boiling fraction from vac. distillation of (I) shows bands with max. at 273, 283, and 296 mμ. High-boiling fractions show absorption max. at 265, 276, 287, and 296 mμ. Low-boiling fractions from vac. distillation of pristane show three absorption bands distinct from those of either fraction from (I). O. D. S.

Effect of ions of the lyotropic series on reflexion in the 3 μ. region. A. M. Buswell, R. C. Gore, and W. H. Rodebush (*J. Physical Chem.*, 1941, 45, 543—546).—Dissolved Na salts increase the reflectivity of H₂O in the 3 μ. region and shift the peak of reflexion to higher frequencies. This may mean that the ions tend to destroy the 4-co-ordinated structure of liquid H₂O, making it possible for H₂O mols. to reflect and absorb energy at a frequency more nearly similar to that of the fundamental O—H vibrations in the vapour state. The effect of the salt anion decreases in the order I[−] > CNS[−] > Br[−] > Cl[−] > SO₄^{2−} > NO₃[−] > H₂O. C. R. H.

Absorption of fluorescent light by fluorescent liquids. W. S. Hill (*Ann. Acad. Brasil. Sci.*, 1940, 12, 261—268).—Fluorescent solutions may be identified by the absorption coeff. determined in a colorimeter. F. R. G.

Conjugation of carbonyl groups and the absorption spectrum of triketopentane. M. Calvin and C. L. Wood (*J. Amer. Chem. Soc.*, 1940, 62, 3152—3155).—The absorption spectrum of triketopentane (I) in isooctane at −50° is compared with the spectra of COMe₂ and Ac₂ in C₆H₁₄ at room temp. The introduction of the third adjacent C=O group produces very slight further shift to longer λ and the vibrational structure, exhibited by Ac₂, is absent. (I) has a non-coplanar structure. W. R. A.

Isomeric structure of C₁₈ unsaturated [fatty] acids from their Raman and infra-red spectra.—See A., 1941, II, 159.

Raman spectrum of aqueous potassium cyanate. F. F. Cleveland (*J. Amer. Chem. Soc.*, 1941, 63, 622—623).—Raman displacements and intensities and depolarisation factors of Raman lines are given for fresh and aged aq. KOCN. The fresh solution exhibits three lines with displacements 1225, 1315, and 2171 cm^{−1}, whilst after 3 days these disappear

and three lines are found with displacements 1003, 1033, and 1064 cm^{-1} . Aq. $(\text{NH}_4)_2\text{CO}_3$ and NH_4HCO_3 give displacements of 1020 and 1007 cm^{-1} and suggest that the displacements exhibited by the aged solution arise from the hydrolysis products.

W. R. A.

Raman spectra of acetylenes. III. Five monosubstituted and four disubstituted acetylenes. F. F. Cleveland and M. J. Murray (*J. Amer. Chem. Soc.*, 1940, **62**, 3185—3188; cf. A., 1939, I, 9; 1940, I, 96).—Raman $\nu\nu$, intensities, and depolarisation factors are recorded for 9 substituted acetylenes and tentative assignments of observed $\nu\nu$ have been made.

W. R. A.

Absorption and re-emission of light by *cis*- and *trans*-stilbenes and the efficiency of their photochemical isomerisation. G. N. Lewis, T. T. Magel, and D. Lipkin (*J. Amer. Chem. Soc.*, 1940, **62**, 2973—2980).—Fluorescence and absorption spectra of *cis*- and *trans*-stilbene have been measured. Interconversion of the isomerides by 2537 Å. has been determined. Results are interpreted in terms of the "loose-bolt" theory of Lewis and Calvin (*Chem. Rev.*, 1939, **25**, 273) and the theories of Olson (A., 1931, 578) on the electronically excited states of the isomerides.

W. R. A.

Fluorescence of purines and pyrimidines. (Miss) M. M. Stimson and (Miss) M. A. Reuter (*J. Amer. Chem. Soc.*, 1941, **63**, 697—699).—The fluorescence of 20 purines and pyrimidines, derivatives of uracil and adenine, has been studied in the solid state and in NaOH, aq. NH_3 , and H_2SO_4 ; generally, the fluorescence in basic solutions is $>$ than in acid solution. The application of these data in the ultrachromatographic purification of the compounds is discussed.

W. R. A.

Ionisation and dissociation of diatomic molecules by electron impact. H. D. Hagstrum and J. T. Tate (*Physical Rev.*, 1941, [ii], **59**, 354—370).—The shapes of the peaks in the graph of resolved ion current as a function of ion-accelerating potential are analysed and accounted for in terms of the wave-mechanical theory of the diat. mol. and the characteristics of the mass spectrometer. Information thus obtained could previously be obtained in part from retarding potential methods and in part from the mass spectrometer. Peak shape and appearance-potential measurements lead to conclusions on the nature of the dissociation process and structure of the mol. Data for H_2 , CO, NO, N_2 , and O_2 are reported and existing discrepancies are cleared up.

N. M. B.

New spectral effect in a barrier-layer photo-effect of carbondum single crystals and a new method for determination of the long wave-length limit. O. V. Losev (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, **29**, 360—362).—An active layer $\sim 1 \mu$. thick, subjected to an accelerating e.m.f. and illuminated with monochromatic light, shows a single component of the photo-effect which approaches a saturation val. with increasing e.m.f. The saturation val. increases relatively to the zero-e.m.f. effect with decreasing λ between 280 and 436 $\text{m}\mu$. The saturation current- λ relation found leads to a val. 645—652 $\text{m}\mu$. for the long- λ limit of the photo-effect.

L. J. J.

Spectral distribution of the barrier-layer photo-effect with carbondum single crystals. O. V. Losev (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, **29**, 363—364).—With layers $\sim 1 \mu$. thick, the photoelectric current produced by monochromatic illumination, in the absence of accelerating e.m.f., is a max. at $\lambda \sim 350 \text{ m}\mu$, and decreases to very small vals. with increasing λ in the region 450—650 $\text{m}\mu$. The max. shifts towards shorter λ with decreasing thickness of active layer.

L. J. J.

Dipole moments of some complex compounds of aluminium chloride. I. A. Scheka (*Ber. Inst. Chem. Akad. Wiss. Ukrain.*, 1940, **7**, 57—69).—The dipole moments have been calc. from the dielectric const. of dil. solutions in C_6H_6 . The moment of $\text{AlCl}_3 \cdot o\text{-C}_6\text{H}_4\text{Cl} \cdot \text{NO}_2$ is 9.48, of $\text{AlCl}_3 \cdot p\text{-C}_6\text{H}_4\text{Cl} \cdot \text{NO}_2$ 7.79, $\text{AlCl}_3 \cdot p\text{-PhOMe}$ 6.54, $\text{AlCl}_3 \cdot o\text{-C}_6\text{H}_4\text{Me} \cdot \text{NO}_2$ 8.92, and $\text{AlCl}_3 \cdot p\text{-C}_6\text{H}_4\text{Me} \cdot \text{NO}_2$ 9.68×10^{-18} e.u. The difference between these moments and those of the free org. mol. is const. and equals 5.3. This indicates an identical deformation of AlCl_3 in all these compounds.

J. J. B.

Dipole moments of lead alkyl and phenyl halides. G. L. Lewis, P. F. Oesper, and C. P. Smyth (*J. Amer. Chem. Soc.*, 1940, **62**, 3243—3246).—The following vals. of dipole moment in C_6H_6 at 25° are recorded: PbPh_3 0, PbMe_2Cl 4.47, PbEt_2Cl 4.39, PbEt_2Cl 4.70, PbEt_2Br 4.46, PbPh_2Cl 4.21, PbPh_2Br 4.21, PbPh_2I 3.73 d. PbPh_3 gives a zero moment because of its dimerisation to Pb_2Ph_6 . Vals. of Pb-halogen bond moments and of the amounts of ionic character in the bonds have been computed.

W. R. A.

Bond moment additivity and the electric moments of some halogenated hydrocarbons. A. A. Maryott, M. E. Hobbs, and P. M. Gross (*J. Amer. Chem. Soc.*, 1941, **63**, 659—663).—Vals. of dipole moments, μ , in the gas state are given for CH_2Cl_2 1.58, CHCl_3 1.02, CMeCl_2 1.79, CHMeCl_2 2.07, CMe_2Cl_2 2.25, *cis*- $\text{C}_2\text{H}_2\text{Cl}_2$ 1.89, and CH_2Br_2 1.43 d. The influence on μ of substitution on a central atom is related to the availability of the electrons of the central atom to the substituent group. The low val. for *cis*- $\text{C}_2\text{H}_2\text{Cl}_2$ is due to resonance in which C—Cl bonds acquire some double-bond character and ionic nature with Cl positive.

W. R. A.

Molecular refraction of ions of *L*-aspartic acid. V. A. Pertzoff (*J. Amer. Chem. Soc.*, 1940, **62**, 3150—3151).—Assuming that Na *L*-aspartate gives the anion

$\text{COO-CH}(\text{NH}_3^+)\text{-CH}_2\text{-COO}^-$ in H_2O , and the anion

$\text{COO-CH}(\text{NH}_3^+)\text{-CH}_2\text{-COO}^-$ in 0.5M-NaOH, vals. of R_L have been calc. from at. and ionic refractions which are in good agreement with experimental vals.

W. R. A.

Electrophiles and electrodeots. N. F. Hall (*J. Amer. Chem. Soc.*, 1941, **63**, 883).—Mols. which share their electron pairs with acids (in Lewis sense) or yield electrons to oxidants have been termed electrodeotic by Luder (*Chem. Rev.*, 1940, **27**, 579). The term "electrodotic" or "electrodotal" is preferred.

W. R. A.

Relation between acidic and basic properties of hydroxides, atomic and quantum numbers, and valency. C. E. Sun and S. T. Li (*J. Chinese Chem. Soc.*, 1940, **7**, 69—72; cf. A., 1937, I, 412).—The val. of the expression Zz/n^3 , where Z is the at. no., z the valency, and n the principal quantum no., is computed for the elements and for several multivalent ions. If the val. is < 1.44 the resulting hydroxide is a base, and if > 1.44 , an acid; the greater is the departure from 1.44, the stronger is the base or acid. When the val. = ~ 1.44 the hydroxide is amphoteric.

F. L. U.

Non-adiabatic reactions. Rotation about the double bond. J. L. Magee, W. Shand, jun., and H. Eyring (*J. Amer. Chem. Soc.*, 1941, **63**, 677—688).—A model of the potential for rotation about the ethylenic double bond is given. Two possible types of isomerisation reactions are discussed; one is an adiabatic reaction having essentially the "normal" properties for first-order reactions, the other is a non-adiabatic reaction of small frequency due to (i) the smallness of the interaction between the two potential surfaces and (ii) only a few of the states in the final potential being available to mols. in the initial potential. The isomerisation of Me_2 maleate and Δ^3 -butene takes place by the non-adiabatic mechanism and calc. and experimental rates are in good agreement. Tunnelling is considered to be negligible in the process.

W. R. A.

Theory of volume magnetostriction. R. Smoluchowski (*Physical Rev.*, 1941, [ii], **59**, 309—317).—Mathematical. A treatment on the basis of mol. field theory. Instead of assuming a saturation magnetisation I independent of vol. at abs. zero, the dependence of I on temp. for coupled and uncoupled electrons is assumed to be given by a Brillouin function. Hence are obtained, with the help of experimental data on the magnetostriction of Fe, the val. for the mol. field "const." N , its dependence on the relative change of vol., and the dependence on vol. of I at $T = 0$. Satisfactory agreement with results obtained from other considerations is found.

N. M. B.

Energy associated with capillary rise. R. C. Brown (*Proc. Physical Soc.*, 1941, **53**, 233—234).—Mathematical. The energy required to raise the column against gravity is shown to equal that required to overcome the viscous forces. By equating their sum to the energy made available by the wetting of the walls of the tube, the usual capillary-rise equation is obtained.

N. M. B.

Densities, surface tensions, and parachors of diborane, boron triethyl, and boron tribromide. Atomic parachor of boron. A. W. Laubengayer, R. P. Ferguson, and A. E. Newkirk (*J. Amer. Chem. Soc.*, 1941, **63**, 559—561).— ρ , γ , and parachor

for B_2H_6 , BEt_3 , and BBr_3 have been determined and the at. parachor of B has been deduced and is found to vary with change in bond type.

W. R. A.

III.—CRYSTAL STRUCTURE.

Correction of X-ray diffraction intensities for Lorentz and polarisation factors. M. J. Buerger (*Proc. Nat. Acad. Sci.*, 1940, 26, 637—642).—The magnitude of the Lorentz correction for X-ray diffraction by a rotating crystal is calc. by consideration of the reciprocal lattice. The correction can be applied in the author's recording method (A., 1939, I, 537) by means of a single rotating cam. The polarisation correction can be applied by surrounding the crystal with an envelope of slightly absorbing material of suitably varied thickness.

L. J. J.

Measurement of particle size by the X-ray method. A. Taylor (*Phil. Mag.*, 1941, [vii], 31, 339—347).—Expressions for the diffraction broadening, β , of X-ray diffraction max. by small crystallites are discussed. A method of obtaining β which avoids lengthy graphical integration is suggested. It is shown that the sudden onset of growth in a small fraction of the crystallites in a specimen leads to anomalous results for the particle size if a small Debye-Scherrer camera is used. The use of a camera of 19 cm. diameter is essential in this case. The order of error involved if a small camera is used, and a fraction of the total sample is bigger than 1000 Å., the remainder being almost unchanged, is calc.

A. J. M.

Analysis of liquid X-ray diffraction patterns. N. S. Gingrich (*Physical Rev.*, 1941, [ii], 59, 290—292).—The corr. intensity curve for the diffraction of X-rays by liquid A (cf. A., 1940, I, 404) is subjected to four different fittings to determine the sensitivity of the at. distribution curve to errors in fitting. An analysis of each fitting is made.

N. M. B.

Diffuse X-ray reflexions. (Mrs.) K. Lonsdale (*Nature*, 1941, 147, 481—482; cf. A., 1941, I, 153).—The physical interpretation of Faxén's formula, that the surfaces of const. intensity surrounding the Bragg points are spheres, is true only when $i - i_B$ is small. Different assumptions, e.g., existence of small groups, waves of the Raman type, or elastic heat waves, give the same formula for small vals. of $i - i_B$ because, in the derivation of each formula, it is assumed that the spreading of the intensity of reflecting power around each reciprocal lattice point is independent of direction; the formulae are a geometrical way of expressing the fact that near the reciprocal lattice points the distribution may be taken as spherical. Experiments show that, in general, the surfaces of isodiffusion, particularly when $i - i_B$ is not small, are not spherical.

L. S. T.

Diffuse reflexion of X-rays. H. A. Jahn (*Nature*, 1941, 147, 511).—The Preston-Bragg block hypothesis (A., 1941, I, 153) is not reconcilable with the Faxén-Waller theory. The general Faxén-Waller expression has been evaluated for various relative vals. of the three elastic consts. of a cubic crystal, and the marked dependence of the scattering power on the elastic anisotropy demonstrated. The theoretical curves of isodiffusion of Na single crystals are reproduced.

L. S. T.

Diffuse scattering of X-rays by potassium chloride crystals. S. Siegel (*Physical Rev.*, 1941, [ii], 59, 371—375).—An extension of work previously reported (cf. A., 1940, I, 285). Using Cu $K\alpha$ radiation, observations in the immediate region of a strong reflexion were made, and shapes and half-widths of the max. were studied as functions of the direction of incidence. Results agree with theory (cf. Zachariasen, *ibid.*).

N. M. B.

Apparent sizes of atoms in metallic crystals with special reference to aluminium and indium, and the electronic state of magnesium. W. Hume-Rothery and G. V. Raynor (*Proc. Roy. Soc.*, 1940, A, 177, 27—37).—The interat. distances in crystals cannot be accounted for by assigning a fixed at. radius to each atom. The causes of this variation are considered in terms of the Brillouin zones of the structures. The apparent sizes of Al and In atoms in the alloys which they form with Cu, Ag, and Au are discussed and shown to be in agreement with theory. New experimental data for the lattice spacings of the solid solutions of Al and In in Mg are given; the a parameter varies smoothly and continuously with concn. but the c parameter shows an abrupt change at 0.75% In or Al.

G. D. P.

Nature of the chemical bond in graphite and boron nitride. A. Brager and H. Shdanov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 629—631).—Using a one-dimensional Fourier series and recorded data for graphite and BN it is shown that the distributions of the electron density perpendicular to (001) in both are similar and that there are between the layers one free electron per C and two free electrons per B-N pair. The layers of BN consist of $B-N^+$ ions, each ion having an electronic configuration similar to C. This would explain similarities in structure and certain physical properties.

W. R. A.

Determination of crystal densities by the temperature-of-floatation method. Density and lattice constant of lithium fluoride. C. A. Hutchison and H. L. Johnston (*J. Amer. Chem. Soc.*, 1940, 62, 3165—3168).—A method for determining ρ to 0.00001 is described which combines "temp. floatation" of small crystals with calibration of the floatation liquid by hydrostatic weighings. ρ^{25} for LiF is 2.63905 ± 0.0001 , and hence the lattice const. is $a^{25} = 4.01736 \pm 0.00004$ Å. in close agreement with the val. (4.01732 ± 0.00004 Å.) from X-ray data of Straumanis (A., 1939, I, 184). The utilisation of ρ and X-ray measurements on LiF in providing a standard of wave-length measurements, or in determining accurately the val. of N , or in comparing the at. wt. of F and Cl, is indicated.

W. R. A.

Interatomic distances in cobalt diselenide. B. Lewis and N. Elliott (*J. Amer. Chem. Soc.*, 1940, 62, 3180—3181).—From X-ray powder photographs of $CoSe_2$ the interat. distances are $Co-Se = 2.43 \pm 0.01$ and $Se-Se = 2.49 \pm 0.04$ Å. The metallic properties of $CoSe_2$ are attributed to the presence of "metallic" electrons not used by Co in the formation of covalent linkages.

W. R. A.

Crystal chemical studies of the alums. II. Purple chrome alums. H. P. Klug. **III. Solid solution studies.** H. P. Klug and L. Alexander (*J. Amer. Chem. Soc.*, 1940, 62, 2992—2993, 2993—2995; cf. A., 1940, I, 349).—II. Lattice consts. at 25° for $MCr(SO_4)_2 \cdot 12H_2O$ ($M = NH_4, K, Rb, Cs, Tl, NH_2Me$) and ρ^{25} have been determined. The NH_4 and K compounds have the α -structure, whilst the others have the β -structure. These structures are compared with corresponding Al alums and it is shown that Rb and Tl compounds have different structures in the two types of alum and that lattice consts. for Cr alums are $>$ those for Al alums by approx. 0.038 Å.

III. Solid solutions of the pairs of alums, $TiAl(SO_4)_2 \cdot 12H_2O$ — $NH_4Al(SO_4)_2 \cdot 12H_2O$ (I), $TiAl(SO_4)_2 \cdot 12H_2O$ — $KAl(SO_4)_2 \cdot 12H_2O$ (II), and $NH_4Cr(SO_4)_2 \cdot 12H_2O$ — $KCr(SO_4)_2 \cdot 12H_2O$ (III) have been investigated by means of X-rays. (I) follows Vegard's law but (II) and (III) show slight deviations in which the size of substituting ions plays an important rôle. The size of ions does not, however, appear to be important from the viewpoint of the distribution ratios between liquid and solid solutions. The co-ordination of Cr in the Cr alums does not change for final mixed alums regardless of the direction of approach to equilibrium. Lattice consts. at 25° for NH_4 and Tl Al alums are 12.215 and 12.206 ± 0.001 Å., respectively.

W. R. A.

Structures of complex fluorides. Barium fluosilicate and fluogermanate. J. L. Hoard and W. B. Vincent (*J. Amer. Chem. Soc.*, 1940, 62, 3126—3129).—The X-ray spectra of $BaSiF_6$ and $BaGeF_6$ have been investigated. The mols. are isomorphous and have a $CsCl$ -like structure of Ba^{++} and $Si(Ge)F_6^{--}$ (approx. regular octahedral) with a rhombohedral angle of $\sim 98^\circ$, 1 mol. per unit cell, a 4.75 and 4.83 Å., α $97^\circ 58'$ and $98^\circ 1'$, respectively, space-group D_{3d}^5 — $R3m$. Each Ba^{++} ion is approx. equidistant from 12 F atoms to give a BaF_{12} co-ordination group, a type of structure predicted for compounds of formula RMX_2 in which $R/X \geq 1$.

W. R. A.

Structure of melamine, $C_3N_3H_3$. I. E. Knaggs and K. Lonsdale. **Optical properties of melamine.** R. G. Wood and G. Williams (*Proc. Roy. Soc.*, 1940, A, 177, 140—147).—X-Ray examination shows that the structure is monoclinic, space-group $P2_1/a$, with 4 mols. in the unit cell. The magnetic anisotropy has been measured and an approx. structure is suggested. New optical data confirm that the structure is of the layer type, and resembles that of all other cyanuric ring compounds that have been examined.

G. D. P.

Crystal structure of selenium diphenyl dibromide. J. D. McCullough and (Miss) G. Hamburger (*J. Amer. Chem. Soc.*,

1941, 63, 803—807).—X-Ray investigation of the orthorhombic crystals of SePh_2Br_2 indicates that they contain 4 mols. per unit cell, a_0 13.95, b_0 5.78, c_0 15.40 Å., space-group D_{2h}^2 —*Pbcm*. The SePh_2Br_2 mol. has an approx. trigonal bipyramidal structure with Se at the centre, Br at the apices, and three equatorial positions occupied by the two Ph and the unshared pair. The mol. symmetry is C_2 —2. Observed bond angles and bond distances are: Br—Se—Br $180^\circ \pm 3^\circ$; C—Se—C $110^\circ \pm 10^\circ$; Se—Br 2.52 ± 0.01 ; Se—C 1.91 ± 0.03 Å. W. R. A.

Crystal structure of tetraphenylarsonium iodide, $(\text{C}_6\text{H}_5)_4\text{AsI}$. (Miss) R. C. L. Mooney (*J. Amer. Chem. Soc.*, 1940, 62, 2955—2959).—X-Ray diffraction data show that AsPh_4I forms tetragonal crystals, space-group S_4^2 —*I4*, 2 mols. per unit cell, a 12.194, c 7.085 Å. Essentially the structure consists of two interpenetrating body-centred lattices, one of AsPh_4^+ ions and the other of I^- ions. AsPh_4^+ ions are tetrahedra with Ph—As distance of 1.95 Å. Each AsPh_4^+ is surrounded at 4.13 Å. by 8 I^- ions. The I co-ordination sphere consists of 16 C. W. R. A.

X-Ray and crystallographic study of ribonuclease.—See A., 1941, III, 387.

Resistance of metals at very low temperatures. S. V. Vonsovski (*J. Physics U.S.S.R.*, 1940, 2, 113—114).—On the basis of Bloch's one-electron model of a metal it is shown that at very low temp. the time of the free path of an electron may exceed the period of the accelerating action of a direct electrical field on an electron in the crystal lattice, with the result that the resistance of the metal tends to infinity, in accord with observations on Au (A., 1938, I, 302). The same inference also follows from Schubon's metal atom model (A., 1936, 134). J. W. S.

Influence of a magnetic field on the electrical conductivity of bismuth single crystals at low temperatures. B. Davidov and I. Pomerantschuk (*J. Physics U.S.S.R.*, 1940, 2, 147—160).—Mathematical. On the assumption that the conductive electrons and positive holes in Bi are few and approx. equal in no., the influence of the quantisation of electrons on the increase of residual resistance in a transverse magnetic field is discussed, and wave equations for "tightly bound" Bloch electrons are derived. It is shown that the no. of collisions responsible for the residual resistance depends only on the energy of the electrons, and the current strength is derived. The theoretical degeneracy temp. is 70°K . (observed 140°K .) and the no. of free electrons (n) is $\sim 0.6 \times 10^{-8}$ per atom. At higher temp. $n \propto T^{1.5}$, this accounting for the increase in the Hall coeff. with decrease of temp. J. W. S.

Hysteresis in ferromagnetics. E. Kondorski (*J. Physics U.S.S.R.*, 1940, 2, 161—181).—The theory developed previously (A., 1940, I, 200) is extended, and approx. formulæ are derived for the variation of the residual magnetism, coercive force, and hysteresis losses with field intensity in an isotropic ferromagnetic comprising infinitely long parallel cylindrical grains, each of which has an axis of easy magnetisation in a field parallel to the geometrical axis. The results are in accord with measurements on cold-drawn Ni and Fe—Ni alloy wires. J. W. S.

Magnetisation near saturation in polycrystalline ferromagnets. T. Holstein and H. Primakoff (*Physical Rev.*, 1941, [ii], 59, 388—394).—Mathematical. The effect of the rotation of the magnetisation vector, under the combined influence of the magnetic field and cryst. anisotropy, on the variation of the magnetisation of ferromagnets near saturation is studied; the Akulov—Gans treatment is amended by taking into account the internal magnetic field arising from the magnetisation itself. Results are applied to the analysis of experimental data. N. M. B.

Optical crystallographic studies with the polarising microscope. III. Measurement of several types of selective dispersion in organic compounds. W. M. D. Bryant (*J. Amer. Chem. Soc.*, 1941, 63, 511—516).—Dispersion measurements have been made on $\text{NH}_2\text{CO}_2\text{Bu}^+$, 2:2'-dipyridyl, *o*-nitroacetanilide, guanylcarbamide picrate, and β -hydroxyethylamine picrate. Other optical characteristics are given and discussed. W. R. A.

Crystal form of sucrose octa-acetate. C. D. West (*J. Amer. Chem. Soc.*, 1941, 63, 630).—Sucrose octa-acetate (I) separates from COMe_2 on keeping for several weeks at room temp. as

prisms, m.p. 84.5° , ρ 1.335. It crystallises in one of the enantiomorphous symmetry classes of orthorhombic bisphenoidal symmetry. The elements for a single crystal have been calc. W. R. A.

Stability of crystal lattices. VI. Properties of matter under high pressure and the lattice theory of crystals. R. Fürth (*Proc. Camb. Phil. Soc.*, 1941, 37, 177—185).—The results of Bridgman (cf. A., 1940, I, 155) on the compression of solids under very high pressure are compared with those obtained theoretically by applying Born's thermodynamic treatment of the properties of crystals. The substances most favourable for comparison are In, S, and Sb. The calc. and observed isotherms (curves of V/V_0 against p/p_0 for different vals. of T/θ , where V_0 is the vol. at abs. zero and vanishing pressure, and p_0 and θ are characteristic consts. of the material, related by the equation $p_0 V_0 = R\theta$) are compared. The theory does not give an exact mathematical description of the experimental results, but provides a rough picture of thermodynamic behaviour. Bridgman's work on the vol. decrement on cooling a substance from room temp. to solid CO_2 temp. at atm. pressure compared with the corresponding decrement at 50,000 atm. also agrees as well as can be expected with Born's theory. The stability of a lattice under uniform negative pressure is also considered. A. J. M.

Behaviour of Young's modulus of β -brass single crystals at low temperature. J. S. Rinehart (*Physical Rev.*, 1941, [ii], 59, 308—309; cf. A., 1940, I, 407).—Measurements on 7 single crystals at liquid O_2 and dry ice— COMe_2 temp. show that the reciprocals of the moduli E in different directions in the crystal lattice vary linearly with temp. down to -183° , and the anomalous variations of E with direction, observed at room temp., persisted. N. M. B.

Origin and spacing of slip bands. E. Orowan (*Nature*, 1941, 147, 452—453).—The fact that the spacing of slip bands on plastically deformed crystals fluctuates about a mean val., which is usually between 0.5 and 10μ , is discussed. A formula for the min. spacing of slip bands is given. The spacing of slip planes is the spacing of the parallel lattice planes enlarged in the proportion of the mol. shear strength to the actual shear stress. L. S. T.

Thermo-allotropic modifications of sulphur. C. Q. Sheely (*J. Chem. Educ.*, 1941, 18, 30).—These modifications are represented diagrammatically. L. S. T.

IV.—PHYSICAL PROPERTIES OF PURE SUBSTANCES.

Magnetic susceptibilities of complex cyanides with transition element cations. J. Richardson and N. Elliott (*J. Amer. Chem. Soc.*, 1940, 62, 3182—3183).—The magnetic susceptibilities of $\text{K}_2\text{MnFe}(\text{CN})_6$, $\text{K}_2\text{CoFe}(\text{CN})_6$, $\text{K}_2\text{CuFe}(\text{CN})_6$, $\text{KCoCo}(\text{CN})_6$, $\text{K}_2\text{CoCo}(\text{CN})_6 \cdot 2\text{H}_2\text{O}$, and $\text{KNiCo}(\text{CN})_6$ have been determined by the Gouy method. The magnetic moments agree with vals. calc. on the assumption that each substance contains a ferro- or cobalti-cyanide ion in which the transition element is forming d^2sp^3 bonds to the CN group and other heavy metals are present as simple ions. W. R. A.

Measurement of adiabatic differential magnetic susceptibility near 1°K . Heat capacity of gadolinium phosphomolybdate tridecahydrate from 0.17° to 4.7° absolute. W. F. Giauque, J. W. Stout, C. J. Egan, and C. W. Clark (*J. Amer. Chem. Soc.*, 1941, 63, 405—410).—Vals. of C_p for $\text{GdPMo}_{12}\text{O}_{40} \cdot 30\text{H}_2\text{O}$ have been determined from 0.187° to 4.192°K . by cooling the sample by adiabatic demagnetisation and supplying energy by an amorphous C thermometer—heater. The vals. agree with calorimetric measurements. The adiabatic differential magnetic susceptibility, $(\partial I/\partial H)$, has been measured by an apparatus which is described. W. R. A.

Velocity of sound in, and chemical reactivity of, bromine and iodine. B. N. Sen (*Current Sci.*, 1941, 10, 22—23; cf. A., 1939, I, 67).—The formula for calculating the velocity of sound in metals can be applied satisfactorily to Br and I, the val. of the numerical const. for metallic elements (2.54) being multiplied by 10. W. R. A.

Heat capacity and entropy of silver iodide and their interpretation in terms of structure. K. S. Pitzer (*J. Amer. Chem. Soc.*, 1941, 63, 516—518).—Vals. of C_p for AgI have been determined calorimetrically from 15.09° to 301.37°K . and the

derived val. of $S_{298.1}^0$ is 27.6 g.-cal. per degree per mol. These and existing data are used in discussing the structure of AgI above and below the transition point 146° K. The increased intensity of coloration of AgI on heating is related to decreasing average co-ordination no. and increasing deviation from pure ionic bond character.

W. R. A.

Heat capacity and entropy, heats of fusion and vaporisation, and vapour pressure of *n*-pentane. G. H. Messerly and R. M. Kennedy (*J. Amer. Chem. Soc.*, 1940, **62**, 2988—2991).— C_p vals. have been measured calorimetrically from 12° to 288° K. The following vals. for n -C₅H₁₂ are given: m.p. 143.47° K. (–129.69°); heat of fusion at 298° K. 2011.2 ± 1; heat of vaporisation at 298° K. 6262 ± 15 g.-cal. per mol.; v.p. from 208° to 298° K. $\log_{10} p_{\text{(mm.)}} = -2312.80/T + 10.18859 \log T + 0.0050000T + 8.75 \times 10^{-7}(260.0 - T)^2 + 34.18793$; mol. entropy of liquid at 298.18° K. 62.78 ± 0.2 and of gas at 1 atm. and 298.18° K. 83.13 ± 0.2 g.-cal. per degree per mol. The torsion of Et against Pr groups in n -C₅H₁₂ is restrained by a potential of ~16,000 g.-cal., which is equiv. to a torsional frequency of ~185 cm.⁻¹ as deduced from the difference between the entropy vals. calc. from thermal and spectroscopic data.

W. R. A.

Thermal data. XIV. Heat capacities and entropies of some compounds having the peptide bond. H. M. Huffman (*J. Amer. Chem. Soc.*, 1941, **63**, 688—689).—Heat capacities from 85° to 298° K. have been measured for *dl*-alanine, glycylglycine, *dl*-leucylglycine, hippuric acid, and hippurylglycine and vals. of $S_{298.1}^0$ are respectively 51.0, 45.4, 67.2, 57.2, and 75.2 g.-cal. per degree per mol.

W. R. A.

Heat capacities of organic compounds containing nitrogen and the atomic heat of nitrogen. S. Satoh and T. Sogabe (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, **20**, 197—203; cf. A., 1941, I, 78).—The mean sp. heats for the range 0—99.6° of *o*-, *m*-, and *p*-nitro-benzoic (I) and -cinnamic acids (II), and NHPhAc and *p*-NO₂·C₆H₄·NHAc have been measured. Vals. of the at. heat of N in the NO₂-group are calc. For both (I) and (II) the calc. at. heat of N decreases in the order *o* > *m* > *p*. The mean val. of the at. heat is 4.22.

O. D. S.

Relation between atomic radii and b.p. C. E. Sun, C. L. Tseng, and S. T. Li (*J. Chinese Chem. Soc.*, 1940, **7**, 65—68).—The empirical relation previously used (cf. A., 1937, I, 505, in which for V^2 read V^3) is applied to the calculation of b.p. of acid chlorides and anhydrides and simple and mixed ketones. There is good agreement between calc. and observed vals.

F. L. U.

B.p. of benzene, $\beta\beta\gamma$ -trimethylbutane, γ -ethylpentane, and $\beta\beta\delta\delta$ -tetramethylpentane within the pressure range 100—1500 mm. E. R. Smith (*J. Res. Nat. Bur. Stand.*, 1941, **26**, 129—134).—The b.p. of these compounds have been determined at various pressures by Swientoslawski's method, using H₂O as reference material. Equations are derived expressing the relationship between v.p. and temp.; the b.p. at 760 mm. are 80.098°, 80.872°, 93.468°, and 122.283°, respectively.

J. W. S.

Transition between liquid and vapour. E. Winning (*Tekn. Tidskr.*, 1940, **70**, 225—226).—It is suggested that a vapour contains only mols. moving in straight lines, whereas a liquid consists mainly of mols. moving in closed paths, with a small no. of "vapour-like" mols. moving in straight lines; these last are responsible for the Brownian movement. Addition of heat to a liquid increases preferentially the speed of the "vapour-like" mols. (assumed to be moving faster than the "liquid-like" mols. in any case), equilibrium being restored by collision of a "vapour-like" with a "liquid-like" mol., giving the latter a straight-line path and thus resulting in vapour formation and absorption of latent heat. Superheated liquids contain less than the equilibrium amount of "vapour-like" mols. The expression: $H_{\text{liquid}} = c_w t + \rho_{\text{vapour}} \cdot l \cdot (\rho_{\text{liquid}} - \rho_{\text{vapour}})$, where $c_w = c$ for the "liquid-like" mols. in the liquid, is derived. It gives close agreement with published vals. of H for H₂O between 10° and 374°, c_w being taken as 0.9951.

M. H. M. A.

Line co-ordinate chart for vapour pressures of organic solvents. D. S. Davis (*Ind. Eng. Chem.*, 1941, **33**, 401).—A nomograph presenting v.p.— T data for eight org. solvents has been constructed from experimental data of Gardner (cf. B., 1940, 332).

C. R. H.

Vapour pressures of organic compounds. I. J. M. Stuckey and J. H. Saylor (*J. Amer. Chem. Soc.*, 1940, **62**, 2922—2925).—V.p. from 4° to 75° of C₆H₆, *o*- and *m*-C₆H₄MeCl and -C₆H₄MeBr, methylcyclohexane, and COMe·C₆H₁₁, are represented by an equation $\log P = -A/(T - C) + B$, whilst the v.p. of *o*-, *m*-, and *p*-xylene, mesitylene, PhEt, and *p*-C₆H₄MeCl fit an equation $\log P = -A/T - 5 \log T + B$. Vals. of the const. are given for each compound.

W. R. A.

Pressure-volume-temperature relations of *n*-hexane and β -methylpentane. E. A. Kelso and W. A. Felsing (*J. Amer. Chem. Soc.*, 1940, **62**, 3132—3134).—Compressibilities of liquid n -C₆H₁₄ and β -methylpentane at 25° intervals from 100° to 225° and P - V - T relations for the gaseous states at 250° and 275° and at different mol. vol. have been determined.

W. R. A.

Alkyls of the third-group elements. I. Vapour-phase studies of the alkyls of aluminium, gallium, and indium. A. W. Laubengayer and W. F. Gilliam. II. Electron diffraction study of indium trimethyl. L. Pauling and A. W. Laubengayer (*J. Amer. Chem. Soc.*, 1941, **63**, 477—479; 480—481).—I. From v.p. and vapour density measurements GaEt₃ and InMe₃ are monomeric in the vapour state, AlMe₃ is dimeric at 70° and ~34% monomeric at 150°, and AlEt₃ is ~12% dimeric at 150°. V.p. data and thermal const. are recorded.

II. The distance In—C in InMe₃ is 2.16 ± 0.04 Å., which is 0.05 Å. < the sum of the tetrahedral radii of In and C and corresponds with a trigonal radius of 1.39 Å. for In. Although most probably the angle In—C—In is 120° and not 109° 28', this cannot be unequivocally decided.

W. R. A.

Calculating Beattie-Bridgeman constants from critical data. S. H. Maron and D. Turnbull (*Ind. Eng. Chem.*, 1941, **33**, 408—410).—The five const., independent of T and P , contained in Beattie and Bridgeman's equation of state can be evaluated for any gas from its crit. const. and from the Beattie-Bridgeman and crit. const. of a reference gas, N₂. The const. for twelve gases have been evaluated and with their aid compressibility vals. have been obtained. These latter agree with observed data over a wide range of T and P , and are generally superior to vals. calc. from van der Waals' equation at all temp. except in the interval $T_c = 1.00$ —1.25.

C. R. H.

Thermal expansion of aluminium from 0° to 650°. A. J. C. Wilson (*Proc. Physical Soc.*, 1941, **53**, 235—244).—Precision measurements of the lattice spacing of Al as a function of temp. by means of a high-temp. Debye-Scherrer X-ray camera, and calc. coeffs. of expansion, are reported. Results are discussed in relation to Grüneisen's law.

N. M. B.

Thermal conductivity of liquids. Twelve industrial chlorinated hydrocarbons. O. K. Bates, G. Hazzard, and G. Palmer (*Ind. Eng. Chem.*, 1941, **33**, 375—376).—Thermal conductivity data at 20°, 30°, 40°, and 50° for CH₂Cl₂, CHCl₃, CCl₄, *syn*- and *trans*-CHCl·CHCl, CHCl·CCl₂, CCl₂·CCl₂, (CH₂Cl)₂, CH₂Cl·CHCl₂, (CHCl)₂, CHCl₂·CCl₃, and CHMeCl·CH₂Cl are tabulated.

C. R. H.

Thermal conductivity and viscosity of steam at high temperatures and pressures. D. L. Timroth and N. B. Vargaftik (*J. Physics U.S.S.R.*, 1940, **2**, 101—111; cf. A., 1938, I, 566).—The thermal conductivity of steam has been measured at 100—550° and 1—300 atm. by the hot-wire method, with quartz tubes 0.5 mm. wide to avoid error due to convection. The coeff. of thermal conductivity (λ) increases with increase of pressure and the val. of K in the relation $\lambda = KC_r \eta$ increases with rise of temp. and decreases with increase of pressure. Tables are given showing the vals. of λ , η , and K at 200—500° and 1—250 atm. The vals. of Prandtl's criterion for the whole region investigated are also recorded.

J. W. S.

Interrelationships between fluidity, volume, pressure, and temperature in liquids. E. C. Bingham, H. E. Adams, and G. R. McCauslin (*J. Amer. Chem. Soc.*, 1941, **63**, 466—474).—Fluidity-vol. curves of aliphatic alcohols obey the hyperbolic equation $V = A\phi - B/(\phi + D) + C$, where V is the vol., ϕ the fluidity, A , B , and D are const., and $C = \Omega + AD$, where Ω is the mol. limiting vol. Lowering of ϕ by a given amount requires a different reduction in vol. depending on whether vol. is reduced by pressure or by cooling; this is due to the high elasticity of atoms and mols. Accordingly,

two vols., $[C]_P$ and $[C]_T$ exist. $[C]_P$ represents the vol. of the mols. in one g.-mol. in the loosest form of close packing at which $\phi = 0$; $[C]_T$ represents the min. val. of mol. vol. when compression is applied, and ϕ again $= 0$. $[C]_T$ is independent of temp. The data for Hg are discussed. W. R. A.

Viscous and plastic flow. N. A. de Bruyne (*Proc. Physical Soc.*, 1941, **53**, 251—257).—Mathematical. Assuming a modulus of elasticity independent of temp., a relaxation time varying exponentially with temp., and an interaction between elastic strain energy and activation energy, the generalised expression derived for the relation between velocity gradient D and shearing stress S is $S = DGAe(\phi_0 - \phi)^{1/2}V/2GRT$, where V is the vol. of a g.-mol., G is the modulus of rigidity, s is the external shear stress, and s_0 the max. cohesive stress. This equation is shown to be capable of representing the main types of viscous and plastic flow. N. M. B.

Brittleness of liquids. M. Kornfeld and M. Rivkin (*J. Physics U.S.S.R.*, 1940, **2**, 183—185).—Very brief exposure photographs indicate that when a stream of a rosin-transformer oil mixture of $\eta \sim 5 \times 10^3$ poises is deformed with a rate of impact of ~ 23 m. per sec. (rotating arm) or ~ 300 m. per sec. (rifle bullet) it undergoes brittle destruction. J. W. S.

Phenomenological theory of the mechanical properties of amorphous bodies. J. Frenkel and J. Obrastzov (*J. Physics U.S.S.R.*, 1940, **2**, 131—142).—A generalisation of Maxwell's relaxation theory of the elasticity of η of amorphous bodies, including a vol. η as well as the ordinary shearing η , is developed. The theory explains the abnormally large absorption of ultrasonic waves in liquids and the reversible shearing elasticity in addition to the irreversible process. The mol. mechanism of the vol. η is discussed. J. W. S.

Diffusion of water vapour through a slit in an impermeable membrane. J. D. Babbitt (*Canad. J. Res.*, 1941, **19**, A, 42—55).—It is shown mathematically that the mass W of vapour diffusing through unit length of a slit of width $2f$ from a pressure p_1 at a distance β on one side of the slit to a pressure p_0 at an equal distance on the other side is given by $W = \frac{1}{2}\pi D \cdot \log \{ (P - p_1)/(P - p_0) \} / \log (2\beta/f)$, where D = diffusion coeff. and P = atm. pressure. Experimental results for the diffusion of H_2O vapour through slits in Al foil between sheets of fibre-board or plaster-board are in agreement with the theory. F. J. G.

Self-diffusion in zinc. F. R. Banks (*Physical Rev.*, 1941, [ii], **59**, 376—381).—Using long-lived radioactive ^{65}Zn as an indicator, measurements of self-diffusion along the C axis of Zn single-crystals were made at six different temp. The activation energy is 19,600 g.-cal. per mol., and the diffusion coeff. at 410.4° is 9.89×10^{-4} sq. cm. per day. N. M. B.

V.—SOLUTIONS AND MIXTURES (INCLUDING COLLOIDS).

The characteristics of thermal diffusion. S. Chapman (*Proc. Roy. Soc.*, 1940, **A**, 177, 38—62).—When a gas mixture is contained in a vessel in which a temp. gradient is maintained, a concn. gradient is in general set up. The paper discusses the dependence of the thermal diffusion ratio on (a) the ratio of the mol. masses, (b) the concn. ratio, (c) the ratio of the mol. diameters, and (d) three parameters depending on the mode of interaction of unlike mols. Certain special cases are considered in some detail. G. D. P.

Pressure-volume-temperature relations in solutions. IV. Apparent volumes and thermal expansibilities of sodium chloride and sodium bromide in aqueous solutions between 25° and 95° . R. E. Gibson and O. H. Loeffler (*J. Amer. Chem. Soc.*, 1941, **63**, 443—449; cf. A., 1939, I, 605).—Sp. vols. of aq. NaCl and NaBr have been measured throughout the whole concn. range at 10° intervals between 25° and 95° ; the sp. vol. is a function of temp. and concn. From these data thermal expansibilities, and the apparent and partial mol. vols. and expansibilities, have been calc. The main differences between the two solutions arise from the larger polarising power of the Cl^- ion. The Br^- ion has a greater effect in breaking down the H_2O structure than has the Cl^- ion. W. R. A.

Apparent and partial molal volumes of the sodium salts of formic, acetic, propionic, and *n*-butyric acids in aqueous

solution. G. M. Watson and W. A. Felsing (*J. Amer. Chem. Soc.*, 1941, **63**, 410—412).— ρ for aq. solutions of Na salts of HCO_2H , $AcOH$, $EtCO_2H$, and Pr^iCO_2H have been determined at 25° , 30° , 35° , and 40° . The apparent and partial mol. vol. have been deduced; the apparent mol. vol. of CH_3 at infinite dilution is ~ 14.6 ml. and increases slightly with increasing concn. W. R. A.

Measurement and explanation of so-called "crystallisation force." C. W. Correns and W. Steinborn (*Z. Krist.*, 1939, **101**, 117—133).—The pressure (p) developed in a super-saturated $KAl(SO_4)_2 \cdot 12H_2O$ (I) solution during crystallisation at const. vol. has been calc. from vals. of the vol. change on crystallisation at atm. pressure. $p \propto c/c_s$, where c is the concn. of (I) in the solution and c_s its saturation concn. at the prevailing temp. An apparatus is described for measurement of the max. pressure (P), applied by a flat plate, against which a given face of a (I) crystal will grow; thermodynamic treatment gives $P = (RT/V) \log_e (c/c_s)$ [V = mol. vol. in cryst. (I)], but interfacial tensions (γ), which depend on the material of the plate (glass, mica, gypsum), reduce P or may entirely suppress growth of the face under pressure. The experiments show that the γ vals. for the solution and the {111}, {110}, and {100} faces of a (I) crystal are different. Experiments demonstrating the development of pressure by crystallisation and hydration are described. A. J. E. W.

Electrical properties of solids. VI. Dipole rotation in high polymerides. VII. System polyvinyl chloride-diphenyl. R. M. Fuoss. VIII. Dipole moments in polyvinyl chloride-diphenyl systems. R. M. Fuoss and J. G. Kirkwood (*J. Amer. Chem. Soc.*, 1941, **63**, 369—378, 378—385, 385—394; cf. B., 1939, 1281).—VI. The a.c. properties at 60—10,000 cycles per sec. over the temp. range -30° to 120° have been determined for the systems: polyvinyl chloride (I); (I)- Ph_2 80:20; polystyrene (II); (II)- p -chlorodiphenyl (III) 90:10 and 80:20; poly- p -chlorostyrene (IV) alone and with varying amounts of Ph_2 , p - (V) and o -chlorodiphenyl (VI) and mixtures of (V) and (VI). The primary effect of changing temp. is to change the internal η . The characteristic max. in absorption and dispersion of ϵ is determined by (a) the size and strength of the polar group, (b) the length and flexibility of the bond of the polar group to the polymeride chain, and (c) the nature and amount of a second component present as a plasticiser. Results suggest that the fundamental mechanism of a.c. response is dipole rotation in a medium of high η with an internal rotatory Brownian motion. For (I) a transition temp. at 70 — 75° exists and an internal melting process appears to occur.

VII. The system (I)- Ph_2 has been studied from -70° to 100° at 60—10,000 cycles per sec. and 0—20% of Ph_2 . Results are in accord with theory and it is concluded that (a) the low-temp. absorption in polar polymerides is reduced and finally eliminated by the addition of a second component, (b) the a.c. loss factor, ϵ'' , as a function of composition for a given frequency f and temp. passes through a max. at a concn. characteristic of a given plasticiser, and (c) the electric properties are markedly non-linear in the low-concn. range of composition.

VIII. A method is given whereby the distribution of times of relaxation of a polar system can be calc. from the observed ϵ'' - f curve. The reduced polarisation is introduced as a simplification in calculating a.c. properties of polar systems. The average moment per monomer unit of a linear polar polymeride, assuming free rotation, is $\sqrt{3}\mu_0/2$, where μ_0 is the moment of the equiv. group in free space. The experimental ϵ'' - f curves for (I) can be represented empirically by an equation. A val. of 2.0 for the average moment of C-Cl in (I) has been found. W. R. A.

Relation of density and refractive index to composition of glass.—See B., 1941, I, 101.

X-Ray study of potash-silica glass. J. Biscoe, M. A. A. Druesne, and B. E. Warren (*J. Amer. Ceram. Soc.*, 1941, **24**, 100—102).—A Fourier analysis of the X-ray diffraction pattern intensity curves of two K_2O-SiO_2 glasses (K_2O 20.9 and 29.1%) indicated a structure similar to that of the Na_2O glasses (B., 1938, 1036), each Si atom being tetrahedrally bonded to 4 O atoms with each O atom bonded to either 1 or 2 Si atoms. The K atoms are situated in holes in the network with an average of ~ 10 O neighbours. J. A. S.

Structure of solid glasses as revealed by electrical conductivity. R. L. Muller (*Bull. Acad. Sci. U.R.S.S., Sér. phys.*, 1940, 4, 607—615).—If the conductivity κ of the system $M_2O-B_2O_3$ in the amorphous state at 250° is plotted against the vol. concn. c of the alkali metal ($g\text{-ion per c.c.}$), the points for $M = Li, Na, K, Rb, Cs$, and Ag at $c > 0.01$ fall on one curve; the individual properties of ions are important at $c < 0.01$. Cations in glass are either near an ionised O and immobile, or near a non-ionised O and mobile. The equilibrium between mobile and immobile cations is calc.; its variation with c accounts quantitatively for the κ - c relation. The temp. coeff. of κ depends on the energy of dissociation of O-M bonds; this energy falls from about 70 to about 35 kg.-cal. when c increases from 0.005 to 0.02. The κ at 250—300° of glasses containing Na and K in the total concn. of 0.017 changes with the ratio $[Na]:[K]$ so as to suggest that these glasses are non-homogeneous mixtures of Na borate and K borate. J. J. B.

Structure of liquid binary mixtures of glasses and salts as revealed by their viscosity and electrical conductivity. E. S. Evstropiev (*Bull. Acad. Sci. U.R.S.S., Sér. phys.*, 1940, 4, 616—626).—In the graph $\log \eta$ against mol.-% p straight lines are obtained if the system forms only a eutectic; if a chemical compound is formed two straight lines are observed making an angle at the composition of the compound. A similar rule holds for conductivity and p . It is confirmed for $Na_2Si_2O_5-PbSiO_3$, $Na_2SiO_3-PbSiO_3-SiO_2$, and $PbO-SiO_2$. Published data for salt mixtures (e.g., $TiNO_3-AgNO_3$ and $KCl-MgCl_2$) also confirm it. Some exceptions (e.g., $LiCl-KCl$) are also found. The results are best accounted for by the assumption that liquid glasses are "micro-heterogeneous" mixtures of several components. J. J. B.

The work of the State Optical Institute on the structure of glass. I. V. Grebenshtchikov (*Bull. Acad. Sci. U.R.S.S., Sér. phys.*, 1940, 4, 579—583).—Transformations occur in glass at very low temp. Glasses rapidly cooled from 85—120°, 140—165°, and 180—210° have different refractive indices presumably connected with transitions $\alpha \rightarrow \beta \rightarrow \gamma$ of tridymite and $\alpha \rightarrow \beta$ of cristobalite. Some borosilicates when annealed can be dissolved in acids, leaving a skeleton of SiO_2 with an admixture of B_2O_3 and Na_2O . Fire-polished tubings of the same glass only crack in acids; the cracks are normal to the length of tubing. This indicates an orientation of mols. in glass. J. J. B.

Structure of glass derived from X-ray analysis and study of optical properties. A. A. Lebedev (*Bull. Acad. Sci. U.R.S.S., Sér. phys.*, 1940, 4, 584—587).—Annealing of glasses of the system Na_2O-SiO_2 reveals two blurred max. corresponding with SiO_2 (cristobalite or tridymite) and Na_2SiO_3 . Presumably crystals of these compounds, 7 to 15 Å. in length, are always present in glass; their transformation causes changes of n on annealing at definite temp. (see preceding abstract). J. J. B.

Elastic and viscous properties of several potash-silica glasses in the annealing range of temperature. N. W. Taylor and R. F. Doran (*J. Amer. Ceram. Soc.*, 1941, 24, 103—109).—Measurements of η and elastic elongation similar to those previously made on Na_2O-SiO_2 glasses (B., 1937, 1204) were made on fibres of K_2O-SiO_2 , $K_2O-CaO-SiO_2$, and $Na_2O-CaO-SiO_2$ glasses at the annealing temp. The delayed elastic distortion, which is more complex than in the Na_2O-SiO_2 series, is represented by the two-term form $l_0(1-e^{kt})$, indicating that $> one kind of "molecule" is oriented by the tensional stress, and is associated with an activation energy of 57—96 kg.-cal. (< that of Na_2O-SiO_2 glasses). The activation energy of viscous flow, which is 105 kg.-cal. (150 for Na_2O-SiO_2 series), is independent of the K_2O content and is determined by the K-O bond. The mechanism of elastic deformation is discussed from the mol. viewpoint. J. A. S.$

Vitreous state. O. K. Botvinkin (*Bull. Acad. Sci. U.R.S.S., Sér. phys.*, 1940, 4, 600—603).—Glasses consist of chemically homogeneous aggregates. X-Ray patterns of glasses are due to incipient devitrification. Only spacings of SiO_2 and $NaBO_2$ are revealed by X-rays or electrons since only these substances have a high rate of formation of nuclei and, therefore, form numerous crystals. $Na_2Si_2O_5$, $Na_2CaSi_4O_{10}$, etc. form few large crystals and cannot be detected. J. J. B.

Crystallisation in silicate slags and glasses. E. Preston (*Trans. Faraday Soc.*, 1941, 37, 209—220).—In the binary eutectic range of materials such as technical glasses and slags the individual cryst. characters of each phase are retained, in contrast to the observed behaviour of metals. The growth of certain cryst. species from glass in relation to time and temp. is illustrated by diagrams. At temp. below that of max. crystallisation velocity (T_M) there is a linear relation between $\log v$ and $1/T_{abs.}$ (v = initial rate of crystal growth). The empirical equation $v = K(1/\eta)^2(T_L - T)$, in which the liquidus temp. is denoted by T_L , is valid for temp. below and above T_M and appears to be applicable, with a suitable const. K , to crystal growth in a wide range of silicate glasses. F. L. U.

Transformations in eutectoid copper-aluminium alloys. IV. Reversibility of the martensite transformation $\beta_1 \rightarrow \gamma'$. G. Kurdjumov and V. Miretzki (*J. Physics U.S.S.R.*, 1940, 2, 143—145).—X-Ray examination of a Cu-Al alloy (Al 14.5%) after quenching shows the presence of β_1 phase (Cu_3Al) at room temp. but only of the γ' phase at liquid air temp. After again warming to room temp. the β_1 phase only is present. With an alloy containing 13.3% of Al, for which the $\beta_1 \rightarrow \gamma'$ change occurs at $\sim 190^\circ$, the reverse change occurs on heating at $> \sim 350^\circ$. J. W. S.

Hall effect and other physical properties of the copper-tin system of alloys. G. G. Andrewartha and E. J. Evans (*Phil. Mag.*, 1941, [vii], 31, 265—282).—The d , resistivity, temp. coeff. of resistance, thermo-electric power, and Hall coeffs. of 34 annealed Cu-Sn alloys have been determined. The results are discussed in relation to the position of the phase boundaries (Cu_3Sn , Cu_2Sn , $CuSn$). The slopes of the resistivity-composition curve and the temp. coeff. of resistance-composition curve show abrupt changes at the phase boundaries. This is also the case for the curve of thermo-electric power against composition, but a max. occurs in this curve at Cu 95% which is not evident in any of the other curves. The d -composition curve does not show marked changes at the phase boundaries. The curve of Hall effect against composition shows change of slope at the phase boundaries, and indicates that the effect is closely connected with the structure and composition of the alloys. Although the Hall coeffs. of both Cu and Sn are negative, the coeffs. for alloys in the neighbourhood of Cu_3Sn and Cu_2Sn have much larger positive vals. Alloys containing ~ 44 and 74% of Cu respectively have zero Hall coeff. There is evidence from the Hall effect of the existence of a narrow phase extending from ~ 61.2 —63% of Cu. The limit of solubility of Sn in Cu is 14%. A. J. M.

Diffusion in α -solid solutions of aluminium.—See B., 1941, I, 186.

Structure and properties of iron-nickel alloys.—See B., 1941, I, 107.

Migration of atoms in iron-nickel alloys. E. A. Owen and A. H. Sully (*Phil. Mag.*, 1941, [vii], 31, 314—338).—The vals. of lattice parameters of samples of Fe-Ni alloys quenched from temp. between 500° and 800° are independent of the annealing temp., but quenching must be rapid and efficient to ensure uniform results. For specimens ranging from pure Ni to 27 at.-% of Ni, quenched from the above temp. to 0°, the addition of Fe causes the Ni lattice to expand almost linearly with at. composition. The lattice parameter reaches a max. of 3.5889 Å. at 15° for an alloy containing 38.6 at.-% of Ni; this max. is at a composition approximating to that of the intersection of the magnetic transformation curve and the γ -($\gamma + \alpha$) boundary, and suggests that the shape of the parameter-composition curve is affected both by the phase boundary and by the position of the magnetic transformation curve. The parameter is unaffected by time of annealing provided this is $> a$ min. period. Difficulties formerly encountered in the determination of the lattice parameter in the two-phase system are due to unsuitability of heat-treatment, and the use of radiation of unsuitable λ . In this region, the curves between composition and parameter of alloys annealed at 500°, 400°, and 350°, respectively, were of different shapes for both α and γ components, according to the heat-treatment to which the alloys had been subjected. The heat-treatment can be varied so as to make Ni atoms migrate either from the α to the γ structure, or vice-versa. α -phase nuclei are formed, which are small enough in the initial stages to cause particle scattering of the incident radiation,

although this component appears to be in equilibrium corresponding with the temp. of annealing. The γ phase does not attain equilibrium with the same readiness, or else the nuclei of the γ phase are even smaller than those of the α phase.

A. J. M.

Solubility of carbon dioxide and nitrous oxide in aqueous salt solutions. A. E. Markham and K. A. Kobe (*J. Amer. Chem. Soc.*, 1941, **63**, 449–454).—Solubilities at 0.2°, 25°, and 40° have been measured for CO_2 in various concns. of aq. KCl, NaCl, KNO_3 , NaNO_3 , $\text{Mg}(\text{NO}_3)_2$, MgSO_4 , Na_2SO_4 , and for N_2O in all except aq. NaNO_3 . A new equation is proposed which expresses solubility in terms of concn. Reduction in solubility is an additive function of ion concn. up to 1.0M.

W. R. A.

Crystal growth. II. D. Balarev and N. Kolarov (*Z. Krist.*, 1939, **101**, 156–160; cf. A., 1939, I, 195).—Further experiments with gypsum at 23° show that the solubility vals. for rising (s_r) and falling temp. (s_f) differ by $\sim 2\%$. If the crystals carry no freshly-deposited material the direction of stirring has little or no effect on s , but if crystals freshly deposited from the solution under given stirring conditions are present, reversal of the direction of stirring raises s_r and lowers s_f ; s_r may then be $> s_f$. These facts are explained in terms of a general theory of crystal growth.

A. J. E. W.

Solubility of sucrose in organic solvents.—See B., 1941, III, 67.

Adsorption of hydrogen on reduced nickel. S. Iijima (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, **38**, 183).—Supplementary notes on previous work (A., 1939, I, 365). Both adsorption and desorption of H_2 on reduced Ni by change in temp. are irreversible. Adsorbed H_2 can be desorbed by evacuation at low temp. only with difficulty. If Ni is reduced at high temp. activated adsorption decreases markedly and van der Waals adsorption slightly. Reduction of Ni at 280° is incomplete. Max. and min. points on the adsorption isobar should shift according to the activity of reduced Ni and the pressure of gas. Van der Waals adsorption is responsible for nearly all the H_2 adsorbed on reduced Ni at -183° .

W. R. A.

Catalytic activity, crystal structure, and adsorptive properties of evaporated metal films. O. Beeck, A. E. Smith, and A. Wheeler (*Proc. Roy. Soc.*, 1940, A, **177**, 62–90).—Films of Ni condensed on glass were found to be highly oriented if the condensation had taken place in an inert gas such as N_2 or A at 1 mm. pressure. Such films have twice the available surface of films evaporated in a vac. and are five times as active. The activity, measured by the hydrogenation of C_2H_4 , increases with film thickness, suggesting that the interior of the film participates in the catalysis and that it must therefore be porous. Adsorption isotherms for C_2H_4 , CO, N_2 , H_2 , and O_2 were obtained and the poisoning of the catalyst by CO and O_2 was studied. Films of Fe, Co, Pd, Pt, and Cu were also investigated and, with the exception of Cu, gave similar results.

G. D. P.

Hysteresis in sorption. I. Permanence of the hysteresis loop. Titania gel–water system. II. Scanning of the hysteresis loop. Titania gel–water system. III. Permanence and scanning of the hysteresis loop. Silica gel–water system. IV. Permanence and scanning of the hysteresis loop. Silica gel–carbon tetrachloride system. V. Permanence, drift, and scanning of the hysteresis loop. Ferric oxide gel–carbon tetrachloride and ferric oxide gel–water systems. VI. Disappearance of the hysteresis loop. Role of elasticity of organogels in hysteresis in sorption. Sorption of water on some cereals. K. S. Rao (*J. Physical Chem.*, 1941, **45**, 500–506, 506–512, 513–517, 517–521, 522–531, 531–539).—I. During the successive sorption and desorption of H_2O by TiO_2 gel at 30° a permanent and reproducible hysteresis loop is exhibited. No explanation other than that based on the concept of cavities with restricted ends satisfactorily explains the data. A slight drift in the loop due to ageing of the gel takes place after a few months. Ageing appears to take the form of compression of the restricted ends of the cavities.

II. The Langmuir and Williams–Henry unimol. adsorption equations when applied to the data show a clear transition from unimol. adsorption to capillary condensation. The result of scanning the hysteresis loop supports the cavity explanation of hysteresis. The adsorption curve is the true

equilibrium curve because during desorption the cavities retain H_2O in a metastable equilibrium.

III. A similar hysteresis loop is exhibited in the adsorption of H_2O by SiO_2 gel at 30° although there is no tendency to drift during ageing. The loop lies within the limits of R.H. 0.35 and 0.94 corresponding with capillary radii of 10 and 160 Å.

IV. A permanent and reproducible loop is exhibited in the sorption and desorption of CCl_4 by SiO_2 gel at 30°. The extent of sorption at saturation pressure and the area of the loop are $<$ in the case of H_2O , suggesting that some of the capillaries in the gel are inaccessible to CCl_4 .

V. The hysteresis loop in the sorption and desorption of H_2O by Fe_2O_3 gel tends to drift during ageing, but the loop in the sorption of CCl_4 by the same gel shows no such tendency. In the former case the sorptive capacity and the area of the loop continually decrease, indicating a decrease in capillary and cavity vol. respectively. The difference between the behaviour of Fe_2O_3 gel towards H_2O and that of SiO_2 and TiO_2 gels is possibly due to coalescence of the colloidal particles of Fe_2O_3 into larger aggregates.

VI. Activated grains of rice and dhal show a hysteresis loop during sorption and desorption of H_2O at 30° which they lose after a few sorptions and desorptions. When H_2O is replaced by CCl_4 the loops are permanent and reproducible. The behaviour with H_2O appears to be connected with the swelling of the grains on the imbibition of H_2O whereby they become elastic and lose their property of entrapping H_2O in the cavities.

C. R. H.

Adsorption at crystal–solution interfaces. XI. Adsorption of isomeric monoazo–dyes by crystals of sodium nitrate, sodium bromate, and sodium chlorate during their growth from solution. W. G. France and K. M. Wolfe (*J. Physical Chem.*, 1941, **45**, 395–401).—Adsorption of 86 acid and basic dyes and the modification in certain instances of crystal habit are described. Although the mol. structure of the dye is some guide to whether adsorption or crystal modification will take place, no simple rule can be formulated.

C. R. H.

Application of Gibbs adsorption equation to solutions of paraffin-chain salts. F. A. Long and G. C. Nutting (*J. Amer. Chem. Soc.*, 1941, **63**, 625–627).—The paradox of aq. paraffin-chain salts having $\gamma < \gamma$ of H_2O , whilst calculation from the Gibbs equation indicates a negative surface excess of solute, is considered. The paradox is more apparent than real, for whilst positive adsorption at the air–liquid interface results in a surface layer of solute, the Gibbs surface excess may be positive, zero, or negative, depending on the conditions. It is concluded that the Gibbs equation in its usual form is valid for solutions of paraffin-chain salts as for other two-component solutions.

W. R. A.

Significance of the forms of union for the desorption of cations. N. I. Gorbunov (*Pedology*, 1940, No. 3, 54–67).—The three forms of union (covalent, ionic, and polar) between ions, mols., and their aggregates are described. Experimental data showing the direct and indirect significance of the forms of union for the desorption of cations from the adsorbed state are discussed.

S. and F. (m)

Surface tension of aqueous perchloric acid at 15°, 25°, and 50° C. C. A. Neros and W. G. Eversole (*J. Physical Chem.*, 1941, **45**, 388–395).—With increase in concn. γ decreases to a min. at $\sim 40\%$ of HClO_4 and rises to a sharper max. at $\sim 65\%$ of HClO_4 , the latter point corresponding with $\text{HClO}_4 \cdot 3\text{H}_2\text{O}$. γ decreases with temp. but the form of the γ -composition curves remains the same. The initial lowering of γ is attributed to the formation of a H bond at the interface.

C. R. H.

Interfacial activity of branched-paraffin-chain salts. G. S. Hartley (*Trans. Faraday Soc.*, 1941, **37**, 130–133).—Theory indicates that the formation of micelles in solutions of paraffin-chain salts should be hindered if for the n -paraffin chain were substituted one containing the same no. of C atoms in two approx. equal branches. A salt of this kind would be expected to produce a greater lowering of the oil– H_2O interfacial tension (γ) than that caused by the corresponding n -chain salt. These predictions are confirmed by a comparison of dialkyl ethers of K resorcinolsulphonate with K n -hexadecoxytoluenesulphonate (I), the former containing alkyl groups with 14 + 2 (II), 12 + 4 (III), 10 + 6 (IV), and 8 + 8 (V) C atoms. At a concn. of 0.01% (I) is more effective than any of the branched-chain compounds, and more effec-

tive than (II) and (III) at higher concns. At 0.02% and higher concns. (IV) and (V) are superior to (I), (V) being the most effective. Thus at 0.08% γ for H_2O -cyclohexane was reduced to 1.12 dyne per cm. by (I) and to 0.04 dyne per cm. by (V). F. L. U.

Interfacial tension, viscosity, and potential changes produced by insoluble monolayers at the oil/water interface. A. E. Alexander (*Trans. Faraday Soc.*, 1941, **37**, 117—121).—Experimental methods of measuring the properties named and the results so far obtained are summarised. For small reductions of the interfacial tension the areas per mol. at an oil- H_2O interface are \gg at an air- H_2O interface, but with increasing interfacial pressure the two areas approach until finally an identical packing is observed. Considerable information about the behaviour of monolayers at an oil- H_2O interface is obtainable from experiments with an air- H_2O interface. F. L. U.

Horizontal orientation and solvation of molecules in adsorption layers. A. B. Taubman (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, **29**, 22—26).—The surface tension isotherms for solutions of hydrocarbons: C_6H_6 , C_{10}H_8 , $\text{C}_{16}\text{H}_{14}$, Ph, C_6H_{14} , $\text{C}_{10}\text{H}_{22}$, cetene, and cyclohexane, in PhNO_2 have been determined and compared with those of $\text{Bu}^\omega\text{OH}$, $n\text{-C}_6\text{H}_{17}\text{OH}$, $\text{Pr}^\omega\text{CO}_2\text{H}$, $\text{C}_6\text{H}_{19}\text{CO}_2\text{Et}$, and Et_2 sebacate (I) in PhNO_2 . The isotherms of the polar compounds, with the exception of (I), deviate from Sziszowski's equation (A., 1908, ii, 1018) at low concn., indicating that cohesion forces between the chains become important at low concn. The mol. const. of these compounds indicate that they are oriented vertically in the surface. The non-polar compounds obey Sziszowski's equation at all concns., indicating that these compounds are completely solvated and that they are oriented horizontally. This is confirmed by calculation of the thickness d of the adsorption layer and the area A occupied per mol. For the non-polar hydrocarbons d is const. in a homologous series, while A increases with chain length. The horizontal orientation of (I) is ascribed to the symmetrical position of the polar groups. O. D. S.

Effect of salts on soluble ionised monolayers. A. B. D. Cassie and R. C. Palmer (*Trans. Faraday Soc.*, 1941, **37**, 156—168).—A theory is developed and expressions are derived for the distribution of ions under a monolayer of a surface-active strong electrolyte. The theory is in quantitative agreement with data on the effect of added electrolytes on the interfacial properties of such films and explains the fact that an appreciable effect is caused only by ions of opposite sign to the film. Surface equations of state, surface potentials, the work of adsorption, and the crit. concn. for micelle formation are discussed with reference to the theory. F. L. U.

Orientation at the oil-water interface of esters and their digestion by pancreatin. J. H. Schulman (*Trans. Faraday Soc.*, 1941, **37**, 134—139).—The results obtained by Williams (A., 1940, I, 440) on the electrophoresis of aliphatic ester emulsions are interpreted in terms of the mol. configuration of the esters, in agreement with conclusions previously reached on the basis of measurements of the rate of hydrolysis by NaOH of esters spread as monolayers at the air- H_2O interface (A., 1937, I, 562). Measurements of the rate of digestion of a series of esters by pancreatin show that the accessibility of the ketonic C atom to the enzyme is determined chiefly by the length of the acid chain. Thus esters of acids C_2 , C_3 , and C_4 are digestible, C_5 , C_6 , and BzOH indigestible, and C_8 digestible. Lengthening of the alcohol chain has an adverse influence on the digestible esters but no influence on the indigestible. Pictures of the oriented mols. are given in which the ketonic C is shown exposed to attack by the assumption of a *cis* configuration by the acid and alcohol chains, and protected by the assumption of a *trans* configuration. The lipoclastic action of pancreatin is inhibited by long-chain sulphates but assisted by other types of capillary-active salts, the latter action being due to protein dispersion. F. L. U.

Cell permeability and diffusion across the oil-water interface. J. F. Danielli (*Trans. Faraday Soc.*, 1941, **37**, 121—124).—A simple theory of the permeability (P) of thin (~ 50 Å) oil layers by aq. solutes of the type $\text{R}(\text{OH})_2$ is put forward and expressions for P are derived. Vals. of the P of five typical cells for $(\text{CH}_2\text{OH})_2$, glycerol, and erythritol are of the same

order of magnitude as the vals. calc. on the theory for a layer of oil having $\eta \sim 10^5$ times that of H_2O . F. L. U.

Mechanism of boundary lubrication. I. Action of long-chain polar compounds. O. Beeck, J. W. Givens, and A. E. Smith. **II. Wear prevention by addition agents.** O. Beeck, J. W. Givens, and E. C. Williams (*Proc. Roy. Soc.*, 1940, A, **177**, 90—102, 103—118).—I. The structure of thin films of lubricant rubbed on polished mild steel surfaces was investigated by electron diffraction. Those lubricants showing little or no surface orientation have a const. coeff. of friction (μ) ~ 0.1 . With oils which show high surface orientation imparted by the addition of a long-chain polar compound a sudden decrease of μ is observed at a crit. velocity depending on the compound used. The effect is explained by the wedging of oil under the surface, and it was shown that the electrical resistance between the sliding surfaces becomes very great when μ decreases. The experiments show that the long-chain compounds act by inducing the wedging effect and do not protect the surfaces from wear.

II. The action of wear-preventing agents is connected with their polishing action. The elements of group V of the periodic table are particularly effective; they form a metallic phosphide or homologue on the surface, lowering its m.p. markedly and thus aiding in maintaining polish. Accurate measurement of wear was carried out by using metal-plated steel balls as the sliding elements. The addition of 1.5% of PPh_3 or AsPh_3 in white oil reduces wear by factors of 7.2 and 12.2; this reduction can be doubled by the addition of 1% of a long-chain polar compound. G. D. P.

Physico-chemical foundations of flotation of native metals.—See B., 1941, I, 109.

Hydration of carbon dioxide and stability of hypochlorite aerosols. P. V. Youle (*Nature*, 1941, **147**, 59).—A comment on recent work (cf. A., 1941, III, 306). L. S. T.

Factors governing the stability of oil-in-water emulsions. A. King (*Trans. Faraday Soc.*, 1941, **37**, 168—180).—Recent work by the author and others on oil-in- H_2O emulsions is reviewed. The principal conclusions are that stability depends chiefly on the presence of a complete and mechanically strong interfacial film, and that as the concn. of the emulsifying agent is increased the character of an emulsion changes from hydrophobic to hydrophilic; when the globules are surrounded by a complete film of emulsifier the electrical stability factor becomes relatively unimportant and the emulsion then resembles a protected colloid. F. L. U.

Stabilisation of water-in-oil emulsions by oil-soluble soaps. R. C. Pink (*Trans. Faraday Soc.*, 1941, **37**, 180—184).—When 2% solutions of certain oleates and stearates in C_6H_6 are shaken with H_2O , Ni and Zn oleates are unaffected, Mg oleate and Mg stearate are almost wholly removed from solution, and Ca and Sr oleates and Ni stearate are partly removed. If these soaps are used as emulsifiers by shaking their C_6H_6 solutions with an equal vol. of H_2O there is an exact correlation between their emulsifying power and the pptn. referred to; thus Mg oleate and Mg and Ni stearates form stable emulsions, Ca and Sr oleates poor emulsions, and Ni and Zn oleates no emulsions. An oil-sol. soap acts as an emulsifier for H_2O -in-oil emulsions only when it is pptd. from its oily solution by H_2O , and when the pptd. soap is insol. in both phases. Further necessary conditions are that the soap must be partly wetted by both liquids, and that there is sufficient lateral adhesion between the solid particles. F. L. U.

Preparation of purified kaolinite suspension.—See B., 1941, I, 176.

Ionic size in relation to fixation of cations by colloidal clay.—See B., 1941, III, 116.

Viscosity and the nature of substances of high mol. wt. in solution. F. Eirich (*Physical Soc. Rep. Progr. Physics*, 1940, **7**, 329—254).—A progress report. W. J.

Crystallisation phenomena in raw rubber.—See B., 1941, II, 165.

Non-isothermal gel-sol-gel transformation of mixed gelatin-methylcellulose systems. W. Heller (*J. Physical Chem.*, 1941, **45**, 378—388).—Mixed colloidal dispersions of gelatin (I) and methylcellulose (II) in H_2O form coacervates. The two phases behave independently, (I) or (II) sols setting to a gel according to whether the system is cooled or heated. If the

system is shaken and immediately cooled, a complete gel is formed without separation, and if the system is heated after shaking a similar complete gel is also formed. In the former case the (I) gel can include ~85 vol.-% of (II) sol, and in the latter the (II) gel can include ~30 vol.-% of (I) sol. The behaviour is only slightly influenced by p_H changes. Changes in transparency with reduction in temp. suggest that (I) and (II) influence the degree of hydration of each other, the probability being that (I) dehydrates (II).

C. R. H.

Refractive indices of protein solutions. S. Shinano (*J. Agric. Chem. Soc. Japan*, 1941, 17, 115—121).— n_D vals. for solutions of crab flesh proteins in aq. NaOH are recorded. With const. amounts of NaOH and varying amounts of proteins, or with varying amounts of NaOH, n_D is not \propto the concn. of protein.

J. N. A.

Keratin chemistry.—See B., 1941, II, 142.

Combination of wool protein with acid and base.—See B., 1941, II, 77.

Breaking strength of lyogels. C. R. Bailey (*J. Physical Chem.*, 1941, 45, 493—500).—The breaking strength (S) of gels containing various proportions of Wyoming bentonite in H_2O with and without K_2SO_4 has been investigated. S increases with increase in clay content, the increase being approx. linear above 6% of clay. Mixtures containing <~3% of clay show no detectable S . This mixture has been termed a "prime suspension." If K_2SO_4 is added to the prime suspension S increases. Starting with the prime suspension the change in concn. of additional clay bears a const. ratio to the change in concn. of K_2SO_4 which will induce the same change in S . From this it is argued that it is the charge on the additional clay particles which causes gelation, and that at low concns. it is the amount of charge which determines gelation irrespective of whether it is carried by a small mobile ion or by a large flat clay particle. The rate of change of S with time $\propto S$, so if it is assumed that $S \propto$ no. of oriented clay particles, then the rate of orientation of such particles \propto no. of particles already oriented in the gel structure.

C. R. H.

Effect of p_H on the electrophoretic mobility of emulsions of certain hydrocarbons and aliphatic halides. W. Dickinson (*Trans. Faraday Soc.*, 1941, 37, 140—148).—The substances examined were purified until they showed a const. mobility (u) which was not changed by further purification, and the same u vals. were obtained from emulsions prepared in three different ways. $n-C_{18}H_{38}$ and paraffin wax give u - p_H curves that coincide up to p_H 5.5, above which they diverge slightly. The curves for $C_8H_{17}I$ and $C_{18}H_{37}I$ coincide throughout the whole p_H range studied, viz., 2—12, whilst that for $C_{18}H_{37}Br$ diverges above p_H 4 to lower u vals. The curves for $C_{12}H_{25}Cl$, $C_{18}H_{37}Cl$, and $C_{18}H_{37}I$ coincide throughout the entire range. All the substances have a slight positive charge at p_H 2, and this is reversed between p_H 2 and 3 and thereafter becomes increasingly negative with rising p_H . The curves are all concave to the p_H axis, and those for the halides become relatively flat beyond p_H 8. The source of the negative charge and the effect on u of the nature of the end-group are discussed.

F. L. U.

Anomalies between electrophoretic mobility and interfacial tension data for paraffin-chain salt solutions. J. Powney and L. J. Wood (*Trans. Faraday Soc.*, 1941, 37, 152—155).—The lowering of interfacial tensions (γ) between H_2O and a hydrocarbon by $C_5H_9N < C_{12}H_{25}I$ is inappreciable at any concn. <0.01%, whereas the max. change in mobility is observed at 0.0004%. Similar discrepancies, though less marked, are found with $C_{12}H_{25}O \cdot SO_3Na$, $C_{14}H_{29}O \cdot SO_3Na$, and $C_{12}H_{25}CO_2Na$. Since the large changes in mobility must be presumed to be due to adsorption of paraffin-chain ions at the interface, it is difficult to explain why there is no corresponding lowering of γ .

F. L. U.

Properties of detergent solutions. XI. Electrophoretic mobilities in dodecylpyridinium iodide solutions. J. Powney and L. J. Wood (*Trans. Faraday Soc.*, 1941, 37, 220—223).—Mobilities of Nujol droplets in aq. $C_{12}H_{25}N < C_{12}H_{25}I$ (I) at 25° and 60° are recorded. The emulsions are extremely sensitive to small concns., the mobility changing from -4.3 to +5.5 μ . per sec. over the concn. range 0—0.0002%. In very dil. solutions the mobility of the more hydrophilic particles of ilmenite and glass is relatively little affected. The effect of

added electrolytes (Na_2SO_4 , $MgSO_4$, $MgCl_2$, $NaCl$) has been studied. The behaviour of Nujol towards (I) closely resembles that observed with the chloride (A., 1940, I, 114); and the large effect produced by very small concns. is not accompanied by an appreciable lowering of interfacial tension (cf. preceding abstract).

F. L. U.

Electrophoresis of complex particles as a function of p_H . Effect of stearic acid in ester particles. G. Growney (*Trans. Faraday Soc.*, 1941, 37, 148—151).—The mobilities of droplets of Et dodecylate containing various amounts of stearic acid do not lie between those of the constituents, and it is inferred that the orientation of the surface layer of stearic acid in the composite droplet differs from that in the pure acid. The effect of p_H on the mobility at various compositions and of composition at various p_H vals. is shown in curves.

F. L. U.

Electrophoresis of lipin-free blood serum.—See A., 1941, III, 386.

Valency effect in the electrophoresis of proteins computed by the Gronwall-La Mer theory. M. H. Gorin (*J. Physical Chem.*, 1941, 45, 371—377).—Theoretical. In deriving the equation $v = v_0/(1 + \kappa r)$ where v = electrical mobility, $v_0 = v$ at infinite dilution, r = protein radius, and κ = ionic strength function, an assumption is made that a hyperbolic sine function equals its argument. This assumption has the effect that the decrease in v with ionic strength for a given net charge predicted from the approx. equation is < that predicted from the more complete equation, the difference (D) disappearing at infinite dilution and at high salt concns. Applying the third-order correction of the Gronwall-La Mer theory it can be shown that D increases as the square of the charge and as $1/r^2$ for a given ionic strength. When the net charge on the protein is <5 valency units and when ionic strength is >0.1M, D is negligible.

C. R. H.

VI.—KINETIC THEORY. THERMODYNAMICS.

Structure of ferric thiocyanate and its dissociation in aqueous solution. H. E. Bent and C. L. French (*J. Amer. Chem. Soc.*, 1941, 63, 568—572).—The coloured complex in Fe^{III} thiocyanate is $FeCNS^{2+}$. This has been shown by the dependence of mol. extinction coeffs. at const. p_H and ionic strength on the concn. of Fe^{III} and CNS^{2-} ions and by dilution experiments and experiments on ionic migration in an electric field. The dissociation const. of $FeCNS^{2+}$ has been calc. No evidence has been found for the ion $Fe(CNS)_2^{2+}$, postulated by Schlesinger and van Valkenburgh (A., 1931, 670).

W. R. A.

Effect of substituents on the acid strength of benzoic acid. I. In methyl alcohol. II. In ethyl alcohol. III. In ethylene glycol and n -butyl alcohol. IV. In dioxan-water. J. H. Elliott and M. Kilpatrick (*J. Physical Chem.*, 1941, 45, 454—465, 466—471, 472—485, 485—492).—I. The strengths of o -, m -, and p -substituted $BzOH$ in MeOH where the substituent is NO_2 , halogen, Me, OMe, and OH have been potentiometrically determined at 25°.

II. Data for the same acids in EtOH are recorded. III. Data in $(CH_3OH)_2$ and Bu^oOH are recorded. The order of strength in each of the four solvents differs from that in H_2O and from the order in the remaining three solvents. A linear relation exists between acid strength and $1/D$ (D = dielectric const.) between $D = 78$ and 25, and agreement between calc. and observed vals. is good except for o -substituted acids in $(CH_3OH)_2$. Extrapolation to $1/D = 0$ gives the intrinsic acid strength, which should be independent of the solvent. The intrinsic strengths of o -substituted acids are > for the corresponding m - and p -derivatives. In general the acid strength of o -substituted acids decreases and the strength of m - and p -substituted acids increases as $1/D$ increases with change of solvent.

IV. Acid strengths in H_2O -dioxan mixtures containing 26.5, 43.5, 61.0, and 73.5% of dioxan do not vary linearly with $1/D$, and have not the same vals. as in H_2O -alcohol mixtures of the same D .

C. R. H.

Activity coefficients of sodium and potassium fluorides at 25° from isopiestic vapour pressure measurements. R. A. Robinson (*J. Amer. Chem. Soc.*, 1941, 63, 628—629).—Isopiestic v.p. measurements of the activity coeffs. of NaF and

KF at 25° have been made and compared with vals. calc. for 25° from f.p. data. Except at 2.0M. the agreement is tolerable. W. R. A.

Solubility studies. II. Activity product and standard electrode potential of silver iodate from 10° to 35°. III. Ionisation constant of iodic acid at 25°, 30°, and 35°. N. C. C. Li and Y. T. Lo (J. Amer. Chem. Soc., 1941, 63, 394—297, 397—399).—II. The solubility and activity coeffs. of AgIO_3 in aq. KNO_3 from 10° to 35° have been determined. The standard potential, ΔS° , ΔH° , and ΔC_p° of the Ag/AgIO_3 electrode, and ΔG° , ΔS° , ΔH° , and ΔC_p° of the reaction $\text{AgIO}_3 = \text{Ag}^+ + \text{IO}_3^-$ have been calc. for 5 temp. between 10° and 35°. The ionic entropy and heat capacity of IO_3^- are, respectively, 29.6 entropy units and 13.6 g.-cal. per degree per mol. and are const. over the temp. range.

III. The solubility of AgIO_3 in aq. HNO_3 at 25°, 30°, and 35° has been determined. Combining these data with those from Part II, the dissociation const. of HIO_3 has been computed for the three temp. W. R. A.

Thermodynamics of bi-univalent electrolytes. VI. Solutions of cadmium iodide from 5° to 40°. R. G. Bates (J. Amer. Chem. Soc., 1941, 63, 399—404).—E.m.f. measurements have been made on the cell $\text{Cd-Hg (2 phase)}|\text{CdI}_2 (0.002-2.0M)|\text{AgI-Ag}$ at 5° intervals from 5° to 40° and activity coeffs., relative partial mol. heat content, and relative partial mol. sp. heat \bar{L}' have been evaluated. The e.m.f. varies linearly with temp. for $[\text{CdI}_2]$ from 0.05 to 2.0M. and therefore L' is const. in this range. W. R. A.

Activity coefficients of silver and chromate ions in gelatin media. A. Van Hook (J. Physical Chem., 1941, 45, 422—431).—The apparent individual activity coeffs. of Ag^+ and CrO_4^{2-} in H_2O and in 1.5 and 3.0% gelatin have been determined. Both ions combine extensively with gelatin, combination decreasing as p_H decreases below the isoelectric point. The effect of added salts on the activity of Ag^+ in gelatin is somewhat erratic but the effect on the activity of CrO_4^{2-} is more regular and is of an interionic character. C. R. H.

Vapour-phase composition of carbon dioxide-water mixtures at various temperatures and at pressures [up] to 700 atmospheres. R. Wiebe and V. L. Gaddy (J. Amer. Chem. Soc., 1941, 63, 475—477).—The composition of the phase rich in CO_2 in equilibrium with the phase rich in H_2O has been determined at 25°, 31.04°, 50°, and 75° at pressures from 1 to 700 atm. and the behaviour of the system is discussed in connexion with the general thermodynamic equation of binary mixtures. W. R. A.

System naphthalene-*p*-nitrophenol: experimental investigation of all the variables in an equation of the f.p. curve. A. N. Campbell and A. J. R. Campbell (Canad. J. Res., 1941, 19, B, 73—85).—The sp. heat and heat of fusion of $p\text{-OH-C}_6\text{H}_4\text{-NO}_2$ (I) are 0.248 ± 0.009 g.-cal. per g. at 0—20°, and 41.7 g.-cal. per g., respectively. The heats of mixing with C_{10}H_8 (II) are small and negative (heat absorbed > 700 g.-cal. per mol.). The v.p. of (I) from 120° to 182° is given, and also some vals. of v.p. and vapour composition for mixtures of (I) and (II). Vals. of ρ , γ , and η for (I)—(II) mixtures are given. The deviation of the mol. vol. from additivity is small and positive. The curves of γ and η against composition are convex to the composition axis, but the deviations from linearity are not great. The departure of the f.p. curve from ideality is discussed in the light of these results. It is shown that the partial pressure of each component in the mixtures is always $>$ that calc. from its mol. fraction, and it is concluded that this deviation from Raoult's law, although not accompanied by marked abnormality of other properties, is responsible for the non-ideality of the f.p. curve. F. J. G.

Thermal, microscopic, and X-ray study of the system $\text{NaPO}_3\text{-Na}_2\text{P}_2\text{O}_7$. E. P. Partridge, V. Hicks, and G. W. Smith (J. Amer. Chem. Soc., 1941, 63, 454—466).—Mixtures of NaPO_3 and $\text{Na}_2\text{P}_2\text{O}_7$ have been investigated by heating and cooling curves, by high-temp. microscopy, by examination of cryst. solid phases by the polarising microscope, and by X-ray methods. NaPO_3 may be obtained in three cryst. forms and $\text{Na}_2\text{P}_2\text{O}_7$ probably in five with reversible transformations. Only one polyphosphate is reported, the tri-polyphosphate, $\text{Na}_3\text{P}_3\text{O}_{10}$, which exists in two cryst. forms. W. R. A.

Thermal analysis of the systems $\text{AlCl}_3\text{-NaCl}$ and $\text{AlCl}_3\text{-KCl}$. U. I. Schvartzman (Ber. Inst. Chem. Akad. Wiss. Ukrain., 1940, 7, 3—11).—The first system gives the compound AlCl_3NaCl , m.p. 152° (decomp.), and two eutectics at 152° and 108° (39 mol.-% of NaCl). The second system gives AlCl_3KCl , m.p. 257° (decomp.), and two eutectics at 257° and 128° (33 mol.-% of KCl). No other compounds can be detected. J. J. B.

Equilibria in the stannous oxide-sodium hydroxide and stannous oxide-hydrochloric acid systems at 25°. Analysis of dilute solutions of stannous tin. A. B. Garrett and R. E. Heiks (J. Amer. Chem. Soc., 1941, 63, 562—567).—The solubilities of SnO in NaOH , HCl , and H_2O have been determined and equilibrium consts., solubility product, heats of formation, and free energies of SnO and Sn(OH)_2 , and heat of hydration of SnO have been calc. Polarographic and potentiometric methods of estimating Sn have been developed. W. R. A.

Equilibrium $\text{Cd} + \text{SnBr}_2 \rightleftharpoons \text{Sn} + \text{CdBr}_2$ in $\text{AlBr}_3\text{-KBr}$ as solvent. J. K. Delimarski and K. S. Miroshnitschenko (Ber. Inst. Chem. Akad. Wiss. Ukrain., 1940, 7, 39—48).—Mixtures of KBr , AlBr_3 , Cd , Sn , CdBr_2 , and SnBr_2 were heated, and the mol. fraction x of Cd in the metal phase was determined. The equilibrium const. $x(1-y)/y(1-x)$, y being the mol. fraction of CdBr_2 in the salt phase, is almost independent of y ; it is 0.005 and 0.009 at 360° and 460°, respectively. J. J. B.

Structure and properties of glasses from the point of view of the phase rule. K. G. Kumanin (Bull. Acad. Sci. U.R.R.S., Sér. phys., 1940, 4, 588—594).—By infinitely slow cooling a liquid glass would pass through several stable phases. The phase which would have separated first determines many properties of the solid glass such as its X-ray pattern, rate of crystallisation, etc. The curve showing the change of viscosity of liquid glass with composition changes its direction when the composition leaves the field of one and enters the field of another phase. J. J. B.

Methodics of the third law of thermodynamics. V. A. Plotnikov (Ber. Inst. Chem. Akad. Wiss. Ukrain., 1940, 7, 23—38).—Planck's assumption that the entropy at abs. zero = 0 is fundamentally different from Nernst's assumption that its change = 0. For the purpose of calculation both hypotheses are equiv. J. J. B.

Heats of dissolution of complex compounds of aluminium bromide and potassium chloride in benzene and toluene. S. I. Jakubson (Ber. Inst. Chem. Akad. Wiss. Ukrain., 1940, 7, 13—16).—From the measured heat of the decomp. of $2\text{AlBr}_3\text{KCl}$ in C_6H_6 or PhMe by H_2O the heat of dissolution is calc.; it is 5.6 kg.-cal. in C_6H_6 and 3.2 kg.-cal. in PhMe . The results make it probable that when KCl dissolves in a hydrocarbon solution of AlBr_3 , no exchange of halogen takes place. J. J. B.

Thermochemistry of complex compounds of aluminium. III. Heat of formation of the complexes of aluminium bromide and ammonium halides. S. I. Jakubson (Ber. Inst. Chem. Akad. Wiss. Ukrain., 1940, 7, 17—22).—From the measured heat of dissolution the following heats of formation of the complex from the salts were calc.: $\text{AlBr}_3\text{NH}_4\text{Cl}$ 16.59, $2\text{AlBr}_3\text{NH}_4\text{Cl}$ 17.36, $\text{AlBr}_3\text{NH}_4\text{Br}$ 13.45, $2\text{AlBr}_3\text{NH}_4\text{Br}$ 15.62, $3\text{AlBr}_3\text{NH}_4\text{Br}$ 16.15, $\text{AlBr}_3\text{NH}_4\text{I}$ 11.82, and $2\text{AlBr}_3\text{NH}_4\text{I}$ 12.24 kg.-cal. Comparison of these vals. with the decomp. potentials of the complex salts in C_6H_6 and EtBr shows that no halogen exchange takes place between AlBr_3 and NH_4Cl , but AlI_3 is formed from AlBr_3 and NH_4I . J. J. B.

Thermochemistry of non-aqueous solutions. I. Heat of dissolution of the bromides and chlorides of aluminium and antimony in nitrobenzene. V. A. Plotnikov and R. G. Vaisberg (Ber. Inst. Chem. Akad. Wiss. Ukrain., 1940, 7, 71—84).—The heat of dissolution in 100 mols. of PhNO_2 , measured directly, was for 0.8—1 mol. of AlCl_3 12.2, for 0.47—0.91 mols. of AlBr_3 24.45, and for 0.77—1.17 mol. of SbCl_3 0.7 kg.-cal. per mol. When 1 mol. of SbCl_3 is dissolved in 240 mols. of PhNO_2 containing 1.07 mol. of AlBr_3 9.6 kg.-cal. are evolved; evidently a chemical reaction takes place. The heat of dissolution per mol. of SbBr_3 is max. (—1.14 kg.-cal.) when 1.7 mol. are dissolved in 100 mols. of PhNO_2 ; at 0.3 mol. it is —0.46. J. J. B.

VII.—ELECTROCHEMISTRY.

Crystal conductivity and relaxation conductivity of amorphous bodies. P. P. Kobeko (*Bull. Acad. Sci. U.R.S.S., Sér. phys.*, 1940, 4, 604—606).—The equation $\log \rho = A + B/T$ for the electric resistivity ρ and temp. T is valid for both cryst. and vitreous forms of LiOAc, Seignette salt, and borax. The vals. of B are almost equal for both forms. At the upper boundary of the vitreous state the equation ceases to be correct, and the relation between ρ and T assumes the form peculiar to liquids.

J. J. B.

Electrolysis of salts through a crystal membrane. V. A. Plotnikov, E. M. Skobetz, and G. A. Kleibs (*Ber. Inst. Chem. Akad. Wiss. Ukrain.*, 1940, 7, 49—56).—15—20% AgNO_3 solutions in two crucibles were connected by a bridge of 50% of $\text{AgBr} + 50\%$ of AgI at 150° , and electrolysed. Ag was deposited on the cathode in the theoretical amount; Ag peroxide and O_2 were formed at the anode. The bridge was gradually destroyed, starting from the immersed ends.

J. J. B.

Standard electrode potential of sodium. E. R. Smith and J. K. Taylor (*J. Res. Nat. Bur. Stand.*, 1940, 25, 731—746).—From e.m.f. measurements on the cells $\text{Na}(s)|\text{NaI}$ in NHMe_2 , Na (0.0651% in Hg) and Na (0.0651% in $\text{Hg})|\text{NaCl}$ (0.05 or 0.1M), $\text{AgCl}|\text{Ag}$, the standard electrode potential of the $\text{Na}(s)|\text{Na}^+$ electrode at $5-40^\circ$ has been determined as $E^\circ = 2.71324 + 0.0007532(\theta - 25) + 0.000000688(\theta - 25)^2$. Vals. of the free energy, entropy, and heat content changes accompanying the reactions corresponding with various combinations of the cells are calc.

J. W. S.

Electrolysis and galvanic concentration cells in the system bromine-pyridine. V. A. Plotnikov and V. I. Michailovskaja (*Ber. Inst. Chem. Akad. Wiss. Ukrain.*, 1940, 7, 85—90).—3 to 4% $\text{C}_5\text{H}_5\text{N}$ solutions in Br were electrolysed between Pt electrodes. 2 mols. of $\text{C}_5\text{H}_5\text{N}$ per faraday are transported from the anode to the cathode compartment. Conc. cells made with Pt electrodes in 0.7—10% $\text{C}_5\text{H}_5\text{N}$ in Br gave up to 0.017 v.; the electrode in the more dil. solution was positive.

J. J. B.

Crystallisation electricity. A. Tschermak-Seysenegg (*Z. Krist.*, 1939, 101, 230—258; cf. A., 1931, 1239).—Supersaturated solutions or supercooled melts of $\text{NaOAc} \cdot 3\text{H}_2\text{O}$, $\text{KOAc} \cdot n\text{H}_2\text{O}$, $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$, $\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$, $\text{NH}_4\text{Cr}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$, and salol are stable for indefinite periods in the absence of nuclei with crystal structures similar to those of the solid compounds. A crystallisation front which moves steadily through the liquid is initiated by cooling a point on the wall of the containing vessel with EtCl or solid CO_2 . An apparatus is described in which currents produced during passage of the crystallisation front between two electrodes are registered by a capillary electrometer and recorded photographically. Various types of electrode are studied, in some of which intermediate solutions and porous diaphragms are used in order to avoid insertion of the electrode in the crystallisation path. The results are illustrated by numerous typical records, and explained in terms of charged zones in the neighbourhood of the crystallisation front. Loss of energy by radiation is not detected during crystallisation.

A. J. E. W.

Redox titrations of vat dye systems.—See B., 1941, II, 76.

VIII.—REACTIONS.

Mechanism of dissolution of aluminium in aqueous or dry phenol. S. I. Volfson, P. F. Michalev, and I. D. Zacharotschkin (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 32—35).—The rate of dissolution of Al in PhOH is decreased by a factor of 13 by the addition of 0.5 vol.-% H_2O . Further addition of H_2O does not affect the rate of dissolution. The rate of dissolution at 160° is $<$ at 183° , the b.p. of dry PhOH , but not sufficiently for the effect of H_2O to be ascribed to the lowering of the b.p. of PhOH . The rate of corrosion is not increased when O_2 is blown through the liquid. It is supposed that the dissolution of Al in PhOH occurs by an electrochemical mechanism, Al ions dissolving from anodic and H_2 being evolved from cathodic sections of the metal surface. In presence of H_2O , mol. $\text{Al}(\text{OH})_3$ would form at the anodic points and protect them from further action.

O. D. S.

Velocity of rapid chlorination. H. C. Thomas (*J. Amer. Chem. Soc.*, 1941, 63, 629—630).—The rate of chlorination of $p\text{-C}_6\text{H}_4\text{Cl}\cdot\text{OH}$ and the rate of the exchange reaction between Cl_2 and HCl^* in C_6H_6 have been studied simultaneously. The velocity of the exchange reaction is \gg the velocity of chlorination.

W. R. A.

Kinetics and mechanism of the coupling of diazonium salts with aromatic amines in buffer solutions.—See A., 1941, II, 130.

Activation energies of some rate-limiting components of respiratory systems.—See A., 1941, III, 386.

Conditions governing steady burning of explosives.—See B., 1941, I, 192.

Reactivity of phenols towards paraformaldehyde. M. M. Sprung (*J. Amer. Chem. Soc.*, 1941, 63, 334—343).—Kinetics of the addition and condensation reactions of 10 phenols and paraformaldehyde at 98° in the absence of H_2O and catalysed by $\text{N}(\text{C}_2\text{H}_5)_3$ have been studied. The additive reaction is apparently of first order and the rate coeffs. decrease in the following manner $m\text{-5-xylenol} > m\text{-cresol} > 2:3:5\text{-C}_6\text{H}_3\text{Me}_3\cdot\text{OH} > \text{PhOH} > o\text{-4-xylenol} > p\text{-xylenol} > p\text{-cresol} > \text{saligenin (I)} > o\text{-cresol} > m\text{-2-xylenol}$. $m\text{-2-Xylenol}$ reacted with only 0.5 mol. CH_2O and the main reaction product is 4:4'-dihydroxy-3:5:3':5'-tetramethyldiphenylmethane. The reaction rates of (I) and of $o\text{-}$ and $p\text{-cresol}$ are approx. the same and suggest that the reactivity of PhOH is depressed to approx. the same extent by a CH_2OH or CH_3 group substituted in the o -position. The effects of variation in the PhOH -paraformaldehyde ratio, catalyst concn. and temp. are discussed. The observed velocity coeffs. are composites of the rates of addition of the first, second, and third mols. of CH_2O . For saligenin the second mol. is added at approx. one third the rate of the first. An examination procedure has been developed to measure the speed of condensation reaction involving the conversion of CH_2OH into CH_2 groups. The condensation rates of reaction are $>$ the addition rates, but are in the same relative order, excepting for saligenin which condenses at a rate approx. equal to that of PhOH . A method is given for estimating the average chain length of the reaction products from the bromination and CH_2O addition data. The heat of activation of the addition reaction is 10,000 g.-cal. per mol., and 15,000 g.-cal. per mol. for the condensation reaction.

W. R. A.

Catalytic action of natural mineral waters. G. Cronheim (*J. Physical Chem.*, 1941, 45, 328—340).—The catalytic decomp. of H_2O_2 by Fe^{++} in mineral waters is discussed. OH' and OH are formed by the oxidation of Fe^{++} and OH institutes a chain reaction in which OH' and H' are formed in equal amounts. Depending on the composition of the mineral water, OH' and H' are taken up in different amounts by secondary reactions, and the p_{H} alters. Decomp. of H_2O_2 is increased by all constituents which tend to bind H' , e.g., H carbonates which react with H' to form CO_2 and H_2O , whereby OH' which normally neutralises the H' is set free and the p_{H} rises. On the contrary decomp. is reduced by OH' -binding constituents, e.g., Ca^{++} . Secondary reactions are able to explain why the rate of decomp. is not const. and why it depends on the initial $[\text{H}_2\text{O}_2]$.

C. R. H.

Reduction of silver ions by quinol and p -phenylenediamine in alkaline solution. T. H. James (*J. Physical Chem.*, 1941, 45, 223—233).—The rate of reduction, R , of Ag^+ by quinol in alkaline solutions of Na_2SO_3 $\propto [\text{Ag}^+]^{0.5}$ at high $[\text{Na}_2\text{SO}_3]$ and low R . As R increases and $[\text{Na}_2\text{SO}_3]$ decreases the dependence of R on Ag^+ increases as $[\text{Ag}^+]$ increases, and if all factors except $[\text{Na}_2\text{SO}_3]$ are kept const. the dependence of R on Ag^+ increases as $[\text{Ag}^+]$ decreases. The data suggest the presence of quinone catalysis and experiments with duroquinol confirm this. In the reduction of Ag^+ by $p\text{-C}_6\text{H}_4(\text{NH}_2)_2$ (I), $R \propto [\text{Ag}^+]$ and $\propto 1/[\text{Na}_2\text{SO}_3]^2$. Adsorption of (I) occurs and the reaction is between this and free Ag^+ . A strong positive neutral salt effect is observed in this reaction and also when $p\text{-NH}_2\text{C}_6\text{H}_4\cdot\text{OH}$, $p\text{-NMe}_2\text{C}_6\text{H}_4\cdot\text{OH}$, and $(\text{NH}_2)_2\text{C}_6\text{H}_3\cdot\text{SO}_3\text{H}$ are the reducing agents. The explanation of these salt effects possibly lies in an increase in (I) adsorption. No effect or a small negative salt effect is observed when NH_2OH or $o\text{-}$ or $p\text{-C}_6\text{H}_4(\text{OH})_2$ is the reducing agent.

C. R. H.

Acid-catalysed esterification of normal fatty acids. H. A. Smith and C. H. Reichardt (*J. Amer. Chem. Soc.*, 1941, 63,

605–608; cf. A., 1939, I, 206).—The acid-catalysed esterification of 0.1N-AcOH, EtCO_2H , $\text{Pr}^n\text{CO}_2\text{H}$, $\text{Bu}^n\text{CO}_2\text{H}$, *n*-hexoic and lauric acid in MeOH at 20°, 30°, 40°, and 50° has been studied and the results are compared with existing data (cf. A., 1939, I, 327). The const., τ , in Goldschmidt's equation is independent of the nature of the org. acid or its concn., and the activation energy is const. at $\sim 10,000$ g.-cal. per mol. in agreement with the val. obtained with 0.5N. solution.

W. R. A.

Lactase of *Escherichia coli*.—See A., 1941, III, 388.

Measurement of fast reactions by absorption spectrophotometry and its application to respiratory enzyme kinetics. F. Karush (*J. Opt. Soc. Amer.*, 1941, 31, 73–76).—The instrument described by Harrison and Bentley (A., 1941, I, 89) is used to record graphically changes in optical density of solutions by comparison with the solvent at the rate of 20 comparisons per sec. Solutions are mixed in the absorption cell in <0.04 sec. by an injection device. The oxidation of guaiacol by H_2O_2 catalysed by horseradish peroxidase was followed by measurements of the absorption of the tetraguaiacol formed at 4750 Å. An induction period of the order of tenths of a sec. is found.

L. J. J.

Catalysis by ascorbic acid. G. G. Rao and T. V. S. Rao (*Current Sci.*, 1941, 10, 24–25).—Ascorbic acid (I), but not $\text{Na}_2\text{S}_2\text{O}_3$, reduces AgCl. For a given concn. of (I) increasing amounts of $\text{Na}_2\text{S}_2\text{O}_3$ cause increased reduction and vice versa. Dehydroascorbic acid reduces AgCl only in presence of $\text{Na}_2\text{S}_2\text{O}_3$, indicating that AgCl is responsible for the oxidation of (I) and $\text{Na}_2\text{S}_2\text{O}_3$ for its re-formation.

J. L. D.

Polymerisation of unsaturated hydrocarbons. I. Acid-catalysed polymerisation of isobutylene. II. Comparison of phosphorus pentoxide and orthophosphoric acid as a polymerisation catalyst. H. Shingu and N. Mutuda (*J. Soc. Chem. Ind. Japan*, 1940, 43, 446–447b, 447–448b).—I. H_2SO_4 and H_3PO_4 catalyse the polymerisation of CMe_2CH_2 , the activity of the former increasing rapidly with increase in acid concn., whereas the activity of H_3PO_4 is less dependent on concn. With pumice impregnated with H_3PO_4 polymerisation increases with rise in temp. to a max. val. at 110–130° depending on the rate of flow of CMe_2CH_2 vapour over the catalyst.

II. The activity of P_2O_5 is similar to that of H_3PO_4 except that max. polymerisation occurs at 60–70° and that less dimeride and trimeride and more higher polymerides are formed than with H_3PO_4 .

C. R. H.

Activation and poisoning of copper hydrogenation catalysts. B. B. Corson and V. N. Ipatieff (*J. Physical Chem.*, 1941, 45, 431–440).—Data are recorded for the activation of Cu by Ni and Co and for the poisoning of the same catalyst by Bi, Cd, Pb, Hg, Sn, NaCl, and Na_2SO_4 in the hydrogenation of C_6H_6 . At concns. $<0.1\%$, Pb, however, acts as a promoter. Al_2O_3 -Ni catalysts are only slightly active. Cu catalysts containing 5 and 10% Co are pyrophoric.

C. R. H.

Mixed copper hydrogenation catalysts. V. N. Ipatieff and B. B. Corson (*J. Physical Chem.*, 1941, 45, 440–443).—Various metallic oxides are able to activate Cu for the hydrogenation of C_6H_6 . The most efficient oxides in order of decreasing effectiveness are CoO_2 , Al_2O_3 , ThO_2 , and Cr_2O_3 . Max. activity is obtained with $\sim 5\%$ of oxide, the efficiency decreasing gradually as the concn. is further increased. With MnO_2 and UO_2 the efficiency, after an initial rise to 5%, remains const. from 5 to 80% of oxide. The efficiency of ZnO and Fe_2O_3 similarly increases rapidly to 5% but further increase in concn. brings about a gradual rise in efficiency to a max. val. at $\sim 70\%$ of oxide.

C. R. H.

Catalysis by activated copper sulphide. A. Wassermann (*Nature*, 1941, 147, 391).— MeCHO (60 g.) and CuS (30 g.), activated by surface oxidation to CuSO_4 , sealed in Pyrex glass and kept at 15–20° for 24 days yield paraldehyde (60% conversion).

L. S. T.

Kinetics of dehydrogenation of *sec*-butyl alcohol and reversible poisoning of copper catalysts. A. A. Balandin and A. L. Liberman (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 794–799).—The irreversible poisoning of Cu catalysts by *sec*-BuOH is not due to any unsaturated alcohol present as impurity. The variation of reaction velocity with rate of passage of vapour and with temp. has been investigated. In the first case, the rate of evolution of H_2 , $k' = (mM)/(M - 2m)$, where M is no. of mols. of vapour of reactant introduced into catalyst tube in unit time, and m is no. of mols. of vapour

of reaction products leaving the tube in unit time. The heat of activation of *sec*-BuOH is 8.6 kg.-cal. per mol. whereas the val. for primary alcohols is 12.8 kg.-cal. per mol.

A. J. M.

Isomerising action of cyclising catalysts. J. Turkevich and H. H. Young, jun. (*J. Amer. Chem. Soc.*, 1941, 63, 519–520).—The aromatising and isomerising properties of cyclising catalysts with $\beta\beta\beta$ -trimethylpentane (I) and *n*-C₇H₁₆ (II) at 475° have been investigated. CrO_3 , CrO , on Al_2O_3 , Al_2O_3 on CrO_3 , and V_2O_5 on Al_2O_3 do not aromatise (I), indicating no isomerisation, whilst with (II) considerable quantities of aromatics are obtained, the olefine content of products from (I) being $>$ from (II). Mo_2O_3 on Al_2O_3 forms small but definite quantities of aromatic compounds from (I), indicating isomerisation, whilst considerable aromatisation of (II) occurs, the amount of olefine products from (I) and (II) being the same.

W. R. A.

Catalytic toxicity and chemical structure. VII. Elimination of catalyst poisons by conversion into derivatives of shielded type. E. B. Maxted and R. W. D. Morrish (*J.C.S.*, 1941, 132–136).—S compounds in which the S atom has unshared electrons are catalyst poisons, but those in which the S atom is electronically saturated are not. Accordingly it should be possible to eliminate poisoning by converting the poison *in situ* into such a shielded compound. This has been realised experimentally. The toxic effect of Et_2S on a Pt hydrogenation catalyst is completely removed by addition of NaOCl, which converts it into non-toxic sulphone. Further the toxic effect of thiophen, the H_4 -derivative of which gives rise to a sulphone, is much reduced by treatment with NaOCl after preliminary hydrogenation.

F. J. G.

Effect of various catalysts on conversion of quartz into cristobalite and tridymite at high temperatures.—See B., 1941, I, 177.

Indium plating.—See B., 1941, I, 185.

Reduction of cystine at the dropping mercury electrode. I. M. Kolthoff and C. Barnum (*J. Amer. Chem. Soc.*, 1941, 63, 520–526; cf. *ibid.*, 1940, 62, 3061).—Cystine, RSSR, is determined polarographically at p_{H} 1, using thymol to suppress the max. The diffusion current \propto the concn. Analysis of current-voltage curves show that reduction of RS-SR to cysteine, RSH, at the dropping Hg electrode does not occur reversibly according to $\text{RS-SR} + 2\text{H}^+ + 2e \rightarrow 2\text{RSH}$, although the effect of p_{H} on potential is given approx. by the equation. For p_{H} 1–2 the reduction waves obtained with RS-SR in buffered solutions show a max. which is repressed by capillary-active substances. For p_{H} 3–9.2 two steps are found in the reduction waves. The first step is attributed to RSH formed by reduction reacting anodically with Hg to form HgSR , and the second step represents the true reduction wave. Capillary-active substances, thymol, camphor, gelatin, PhOH , resorcinol, methylene-blue, and Me-red, markedly shift the curves to more negative potentials and depress max. This effect has not previously been observed in polarographic investigations. The effects of camphor and thymol at different concn. and p_{H} are considered and the observed shift is attributed to the inhibition effects of the capillary-active substances on the orientation or adsorption of RS-SR at the surface of the Hg drop. The potential of RS-SR-RSH solution is a typical "mixed potential". The calc. diffusion coeff. of RS-SR in 0.1N-HCl at 25° is 5.3×10^{-6} sq. cm. per sec.

W. R. A.

Photographic latent image.—See B., 1941, II, 170.

IX.—METHODS OF PREPARATION.

Water; some interpretations more or less recent. G. S. Forbes (*J. Chem. Educ.*, 1941, 18, 18–24).—Recent views on the conditions of formation, the structure, and the co-ordination of H_2O , and the hydration of ions in solution are discussed.

L. S. T.

Basic copper arsenate.—See B., 1941, III, 94.

Hydrothermal and X-ray studies of the garnet-hydrogarnet series and the relationship of the series to hydration products of Portland cement. E. P. Flint, H. F. McMurdie, and L. S. Wells (*J. Res. Nat. Bur. Stand.*, 1941, 26, 13–33).—Treatment of $\text{CaO-Al}_2\text{O}_3\text{-Fe}_2\text{O}_3\text{-SiO}_2$ glasses (0–9% SiO_2) with H_2O at 175–250° yields solid solutions of the isometric forms

of $3\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{H}_2\text{O}$ (I) and $3\text{CaO} \cdot \text{Fe}_2\text{O}_3 \cdot 6\text{H}_2\text{O}$ (II). These solid solutions are also produced by the slow addition of dil. acidified solutions of $\text{FeCl}_3 + \text{AlCl}_3$ to a large vol. of boiling aq. $\text{Ca}(\text{OH})_2$. The products tend to be contaminated with SiO_2 taken up from the glass or porcelain reaction vessel. The decomp. temp. of the solid solutions is the higher the lower is the Fe_2O_3 content. Addition of aq. FeCl_3 to aq. $\text{Ca}(\text{OH})_2$ at room temp. yields the compound, $3\text{CaO} \cdot \text{Fe}_2\text{O}_3 \cdot \text{CaCl}_2 \cdot 10\text{H}_2\text{O}$, which when kept in contact with the mother-liquor slowly yields (II). Glasses containing 27–40% of SiO_2 yield solid solutions of (I) and (II) with $3\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot 3\text{SiO}_2$ (III) and $3\text{CaO} \cdot \text{Fe}_2\text{O}_3 \cdot 3\text{SiO}_2$ (IV). Attempts to replace CaO by MgO , MnO , BaO , or SrO , and Al_2O_3 or Fe_2O_3 by Cr_2O_3 , in these products were unsuccessful. Treatment of $4\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{Fe}_2\text{O}_3$ with excess of H_2O yields mainly (I), but with a smaller quantity of H_2O the solid product contains some (II) in solid solution. The hydration products of the glass phase in Portland cement clinker belong to this series. X-Ray study shows that (I), (II), (III), and (IV) are all cubic and in the space-group O_h^h , with 8 mols. in the unit cell. J. W. S.

Corrosion of metals by non-aqueous solutions. Action of ethyl alcohol on metals. L. G. Gindin, R. S. Ambarzumian, and E. P. Beltschikova (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 44–47).—Al, Zn, and steel (C 0.28%, Mn 0.51%, Si 0.22%) are uncorroded when kept in sealed tubes in presence of air under abs. EtOH for 210 days, or under 99.7% EtOH for 150 days. Under the same conditions Mg undergoes slight focal corrosion. O. D. S.

Corrosion of metals by non-aqueous solutions. R. S. Ambarzumian, L. G. Gindin, and E. P. Beltschikova (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 91–94; cf. preceding abstract).—Mg is corroded by solutions of dry CO_2 in EtOH, H_2 being evolved and a white ppt. formed. The action is mainly confined to corrosion centres, the no. of which increases with time. Al and steel are unaffected by the solution. F. L. U.

Preparation of ammonium hydroxide for laboratory use. K. A. Kobe and T. S. Markov (*J. Chem. Educ.*, 1941, 18, 29–30).—15.5–17N. aq. NH_3 is prepared from liquid NH_3 . L. S. T.

SO as an intermediate product of the oxidation of hydrogen sulphide. N. M. Emanuel, D. S. Pavlov, and N. N. Semenov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 618–620).—In the oxidation of H_2S a slow reaction occurs accompanied by a decrease of pressure and giving relatively stable intermediate products which disappear according to the unimol. law. The absorption spectra of $\text{H}_2\text{S}-\text{O}_2$ mixtures at various times >3 min. show bands attributed to SO. W. R. A.

Non-exchange of cobalt in certain complex salts. J. F. Flagg (*J. Amer. Chem. Soc.*, 1941, 63, 557–559).—Exchange reactions between aq. Co^+SO_4 and $[\text{Co}(\text{NH}_3)_4](\text{NO}_2)_2$, $[\text{CoCl}(\text{NH}_3)_5]\text{Cl}$, $[\text{Co}(\text{pn})_2\text{Cl}_2]\text{Cl}$, $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)_2]$, $[\text{CoCl}(\text{NO}_2)_2(\text{NH}_3)_2]$, and $\text{K}_3\text{Co}(\text{CN})_6$ indicate that the exchange $\text{Co}^{++} \rightleftharpoons \text{Co}^{+}$ does not occur probably because Co^{++} ions are reduced by H_2O more rapidly than by exchange. W. R. A.

Oxidation processes in platinum oxalates. V. I. Goremikin and K. A. Gladischevskaja (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 625–628; cf. A., 1940, 1, 267).—In the oxidation of Pt *trans*-H oxalates, the HC_2O_4 group is oxidised before the Pt, whereas with Pt *cis*-oxalates the Pt is first oxidised. *trans*- $[\text{Pt}(\text{NH}_3)(\text{C}_6\text{H}_5\text{N})(\text{HC}_2\text{O}_4)_2] \cdot 4\text{H}_2\text{O}$, and a red intermediate oxidation product, $[\text{Pt}(\text{NH}_3)(\text{C}_6\text{H}_5\text{N})\text{Cl}]$, have been isolated. The following have been produced and described: $[\text{Pt}(\text{NH}_3)_2(\text{C}_2\text{O}_4)_2]\text{Cl}_2$, $[\text{Pt}(\text{C}_6\text{H}_5\text{N})_2(\text{C}_2\text{O}_4)_2]\text{Cl}_2$, and $[\text{Pt}(\text{NH}_3)(\text{C}_6\text{H}_5\text{N})_2\text{Cl}_2]\text{Cl}$. W. R. A.

X.—ANALYSIS.

Physical basis for spectrographic analysis. W. F. Meggers (*J. Opt. Soc. Amer.*, 1941, 31, 39–46).—A discussion of line strength and persistence in at. emission spectra. Electric arcs are the best exciting sources for first spectra. The strongest lines are invariably those involving *s-p* transitions. Unusual spectral sensitivity is found with elements containing a single *s* electron in the normal state. If the normal state contains 2 *s* electrons, the strongest line may involve a metastable configuration with 1 *s* electron. Where

only *p* electrons are available, spectral sensitivity is low. A table of strongest lines of first spectra and the electronic states concerned is given for all the elements. L. J. J.

Accuracy in chemical analysis. Review of some analytical fundamentals. L. F. Taylor (*Ind. Chem.*, 1941, 17, 59–62, 94–95).—Weighing, glassware, Pt ware, reagents, distilled H_2O , volumetric analysis, factors, and the determination of SiO_2 by way of example, are among the subjects discussed. L. S. T.

Polarography. W. C. Davies (*Ind. Chem.*, 1941, 17, 98–102).—The principle of the method and the apparatus used are described. Examples of applications to qual. analysis, and to the determination of Cd in Zn blende, gases dissolved in H_2O , and oxidation products in Et_2O , are given. L. S. T.

Determination of exchangeable bases by the Lundegårdh spectrographic method. V. R. Ellis and C. E. Marshall (*Proc. Soil Sci. Soc. Amer.* [1939], 1940, 4, 131–135).—Methods of evaluating concns. of cations from the line intensities are compared. Good agreement between the two microphotometric methods and the approx. visual method with quintuplicate samples was obtained. With a recording microphotometer either the reciprocal (L/H) or the difference ($L - H$) of the line transparencies may be used to compare unknown concns. with standards. Details of the accuracy with different metals are given. S. and F. (m)

Spectrophotometric study of universal indicators. J. T. Woods and M. G. Mellon (*J. Physical Chem.*, 1941, 45, 313–321).—Spectral transmission curves for solutions of 15 mixtures of indicators and of proprietary universal indicators have been determined over the range 400–700 mμ. and over the effective p_{H} range. Methoxy-reds and certain phthaleins are suggested as useful ingredients especially if a filter photometer can be employed. C. R. H.

Determination of halogen in mineral oils.—See B., 1941, I, 167.

Determination of iodine in livestock mineral mixtures.—See B., 1941, III, 130.

Improvement in mixing starch solution.—See B., 1941, III, 122.

Fluorescence analysis. VII. Rhodamine B and fluorescein as fluorescence indicators in oxidimetric titrations. VIII. Spectroscopic study of fluorescence tests. H. Goto (*Sci. Rep. Tōhoku*, 1940, 29, 446–460, 461–466).—VII. The use of rhodamine B as indicator in iodometry, bromometry, and permanganometry and of fluorescein in bromometry has been investigated. The range of acidity and of indicator concn. over which they may be used is specified. Accurate results were obtained in solutions coloured by Cr^{+++} ions.

VIII. The fluorescence spectra of the compounds the use of which was previously suggested (A., 1941, I, 219) for the detection of metallic ions have been photographed and are reproduced. O. D. S.

Determination of oxygen in tank hydrogen.—See B., 1941, I, 173.

Determination of sulphur in mineral oils.—See B., 1941, I, 167.

Determination of sulphides in depilatories.—See B., 1941, III, 110.

Determination of sulphur dioxide in beer and wine.—See B., 1941, III, 100.

Standardisation of sulphuric acid. W. H. King (*J. Assoc. Off. Agric. Chem.*, 1940, 23, 542–543).—Standardisation of 0.1N- H_2SO_4 by means of $\text{Na}_2\text{B}_4\text{O}_7$ or by determination of *d* (Pickering-Marshall method) gives accurate results. F. O. H.

Co-precipitation with barium sulphate. M. L. Nichols and E. C. Smith (*J. Physical Chem.*, 1941, 45, 411–421).—Co-pptn. of K salts with BaSO_4 decreases in the order NO_2^+ , NO_2^- , ClO_3^- , Cl^- , MnO_4^- , Br^- , CN^- , I^- , $\text{Fe}(\text{CN})_6^{4-}$, $\text{Fe}(\text{CN})_6^{3-}$. Contamination is reduced by ageing the ppt. Adsorption on the surface of primary particles of BaSO_4 rather than solid solution formation in the interior of the BaSO_4 crystal is the principal factor in the co-pptn. of impurities. C. R. H.

Analytical chemistry of nitrogen compounds. II. Quantitative analysis of nitrous acid in alkaline solution. K. Suzuki (*J. Soc. Chem. Ind. Japan*, 1940, 43, 440–441b).—To a

solution containing ~30 g. of HNO_3 is added a reducing solution containing Na_2CO_3 28, glucose 1.2, FeSO_4 20 g. The NH_3 formed is distilled and titrated. The influence of KNO_3 , acid clay, and kieselguhr has been investigated. C. R. H.

Determination of nitrogen in steel and alloys.—See B., 1941, I, 183.

Volumetric micro-determination of arsenic. C. C. Cassil (*J. Assoc. Off. Agric. Chem.*, 1941, 24, 196—202).—The previously described method (A., 1939, I, 534), applicable to 5—500 μg . of As_2O_3 , has been modified to be applicable to 10 mg. with an error of ~1%. F. O. H.

Micro-determination of boron by means of quinalizarin and a photoelectric colorimeter. L. C. Olson and E. E. DeTurk (*Soil Sci.*, 1940, 50, 257—264).—To the B solution (containing >0.03 mg. in 5 c.c.) is added 98.5% H_2SO_4 . After cooling to 26–7° quinalizarin in 98.5% H_2SO_4 is added. The intensity of the blue colour is either compared with standards or determined by means of a photometer. Blank determinations are essential. 0.0002 mg. of B per c.c. can thus be determined. A. G. P.

Determination of silicon in alloys.—See B., 1941, I, 183.

Determination of silica in acid-insoluble silicates. G. McClellan (*J. Assoc. Off. Agric. Chem.*, 1941, 24, 111—113).—The sample (0.5 g.) is heated with Na_2CO_3 (6 g.) to ~1000°, the melt dissolved in HNO_3 (15 ml.; $\text{HNO}_3:\text{H}_2\text{O} = 3:1$) and then treated with NH_4Cl (5 g.), HClO_4 (20 ml.), and H_2SO_4 (10 ml.). After boiling for 15 min., the mixture is diluted with 150 ml. of H_2O and filtered, the residue being washed, ignited, and weighed as crude SiO_2 . Treatment with HF gives the wt. of SiO_2 . F. O. H.

Determination of silica in calcined alumina.—See B., 1941, I, 173.

Semi-micro-determination of carbon and hydrogen in coals.—See B., 1941, I, 163.

Fluorescence analysis. V. Detection [of metals]. H. Gotô (*Sci. Rep. Tôhoku*, 1940, 29, 204—218, 287—303; cf. A., 1940, I, 418).—Fluorescence reactions of 35 cations with cochineal, 8-hydroxyquinoline, rhodamine B, and morin are described and the sensitivity of the tests determined. Some fluorescence reactions with fused salt beads and with CaO beads are also described. A. R. P.

Spectroscopic analysis of solutions by a modified Ramage flame emission method. R. L. Mitchell (*J.S.C.I.*, 1941, 60, 94—98).—Working concns. for the determination of 15 cations are given and factors affecting their sensitivity discussed. The accuracy of the method, which uses the burner designed by Steward and Harrison (cf. A., 1939, III, 799), is compared with that of the Lundegårdh method; approx. equal accuracy is obtained from quadruplicate determinations by the former and duplicates by the latter method. The use of the ratio rather than the difference of measurements of line and background densities in photometric evaluation is shown to be preferable.

Determination of sodium in aluminium.—See B., 1941, I, 186.

Determination of sodium.—See A., 1941, III, 407.

Flow sheet and material balance of a quantitative experiment. M. Randall and L. E. Young (*J. Chem. Educ.*, 1941, 18, 32—34).—Flow sheets for the pptn. of AgCl and for the Jones reductor and titration with aq. KMnO_4 are reproduced and discussed. L. S. T.

Determination of magnesium and manganese in fertilisers.—See B., 1941, III, 90.

Determination of zinc in magnesium alloys and nickel alloys.—See B., 1941, I, 186.

Rapid determination of zinc in water.—See B., 1941, III, 130.

Detection of cadmium. F. A. van Atta and W. L. Wasley (*J. Chem. Educ.*, 1941, 18, 31—32).—2 ml. of the ammoniacal solution containing $[\text{Cu}(\text{NH}_3)_4]^{2+}$ and $[\text{Cd}(\text{NH}_3)_4]^{2+}$ are evaporated to dryness. The residue is mixed with an equal vol. of Na_2CO_3 (1 part) and powdered C (1 part), and the mixture heated in an ignition tube to dull redness. Cd distils, and is deposited as a grey metallic mirror on the cool parts of the tube. Cu and Bi do not distil at this temp. The Cd mirror

is rendered more visible by adding S to the tube and heating again when the orange form of CdS is formed. L. S. T.

Polarographic determination of indium and cadmium. S. I. Sinjakova (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 376—379).—In can be determined polarographically with a Hg drop cathode in 0.1N- KCl , NaCl , LiNO_3 , ZnCl_2 , or NH_4OAc , with $[\text{In}]$ down to <0.001 mg. per ml. Cu^{2+} , Fe^{3+} , and Pb^{2+} in very small concns. do not interfere. If Cd^{2+} is present, it is determined separately in N-NH_3 , 0.02N- NH_4Cl , a drop of 1% agar, and a crystal of Na_2SO_4 being added. In^{3+} and Cd^{2+} are then determined together in KCl solution. L. J. J.

Analysis of alloys by means of X-rays.—See B., 1941, I, 185.

Determination of copper in soils.—See B., 1941, III, 114.

Determination of mercury in food.—See B., 1941, III, 104.

Gravimetric determination of manganese with 8-hydroxyquinoline. K. Neelakantam (*Current Sci.*, 1941, 10, 21—22).—The heat-stability of Mn 8-hydroxyquinolate (I) depends on the method of pptn. If (I) is pptd. from neutral or weakly acid solution containing NaOAc and a small amount of sulphite or NH_2OH by 8-hydroxyquinoline (II) in EtOH it is decomposed at >110°. If (I) is pptd. from a mineral acid solution containing excess of (II) in AcOH by dil. aq. NH_3 , it is stable to temp. of 150—170°. The influence of large amounts of NH_4Cl , NaCl , and $(\text{NH}_4)_2\text{C}_2\text{O}_4$ on the pptn. of (I) is briefly discussed and a method of determining Mg and Mn in rock analysis is outlined. W. R. A.

Standard solutions. R. L. Vandavey (*J. Assoc. Off. Agric. Chem.*, 1940, 23, 540—542).—The A.O.A.C. method of preparing standard aq. KMnO_4 affords a stable solution. Slight modifications in the official method of standardising acid solutions by means of $\text{Na}_2\text{B}_4\text{O}_7$ are recommended. F. O. H.

Standardisation of potassium permanganate solutions. G. M. Johnson (*J. Assoc. Off. Agric. Chem.*, 1940, 23, 543—546).—0.1N- KMnO_4 , prepared from unboiled H_2O without filtration and acidified with 0.5% of H_2SO_4 , loses 16.3% of its strength in 133 days when kept in the dark. Solutions <0.1N. are prepared by diluting more conc. solutions with H_2O that has been distilled from alkaline KMnO_4 , avoiding contamination by org. matter. Standardisation by $\text{Na}_2\text{C}_2\text{O}_4$, a temp. of 75—85° being maintained throughout the titration, is recommended. F. O. H.

Rapid determination of manganese in feeds.—See B., 1941, III, 105.

Colorimetric determination of iron with sodium salicylate. R. O. Scott (*Analyst*, 1941, 66, 142—148).—A modification of the method described by Snell ("Colorimetric Methods of Analysis," Vol. I, p. 301) has been developed. Optimum conditions, and the errors resulting from variations in conditions and the presence of interfering ions, have been investigated. Under the conditions given, the total Fe is determined since Fe^{2+} and Fe^{3+} give the same colour intensity. In solutions of pure Fe the results are reproducible to 1%. The method can be used for soils and clays, and for concentrates and ppts. for spectrographic purposes; it is particularly useful when only 5—10 mg. of material, containing 2—20% Fe_2O_3 , are available. Interfering ions Ti 0.3, Al 3.5, Mn 12.0, SiO_2 3.0, PO_4^{3-} 4.0, F^- 0.1, and Cl_2 2.0 mg., all per 50 ml. of final solution, can be present. In general, interference from these substances will not occur. In the semi-macro-method described four determinations can be made in 2 hr. L. S. T.

Assay of iron in medicinal syrups.—See B., 1941, III, 131.

Volumetric determination of iron and aluminium in cement with 8-hydroxyquinoline.—See B., 1941, I, 179.

Complex ions. I. Spectrophotometric identification of complex ions in solution. W. C. Vosburgh and G. R. Cooper (*J. Amer. Chem. Soc.*, 1941, 63, 437—442).—The formation of complex ions from a metallic ion A and either a mol. or an anion B according to $A + nB = AB_n$ has been studied by the method of Job (A., 1928, 589) for the formation of $\text{Cr}_2\text{O}_7^{2-}$ ions, the reactions between Ni^{2+} ions and o -phenanthroline (I) and $(\text{CH}_3)_2\text{NH}_2$ (II), and the reactions between Cu^{2+} and NH_3 . If only one compound is formed the absorption of light is independent of λ but if > one compound is formed

the λ of light used is important. (I) and (II) combine with Ni^{++} in ratios 3:1, 2:1, and 1:1; Cu^{++} ions and NH_3 combine in the ratios 1:2 and 1:4. W. R. A.

Radioactive determination of small amounts of uranium. W. D. Urry (*Amer. J. Sci.*, 1941, 239, 191–203).—The determination of small amounts of U ($\sim n$ parts in 10^7) by means of indirect radioactivity measurements can be used only when radioactive equilibrium is known to be established. A direct method for determining such small amounts of U is now described. ^{238}U , ^{235}U , and ^{234}U are separated from other radio-elements by the use of Ce^{++++} , Bi^{+++} , Pb^{++} , and Ba^{++} as co-precipitants for the latter. The Fe_2O_3 and Al_2O_3 in the sample itself are used as carriers in the final pptn. of the U with $\text{Fe}_2\text{O}_3 \cdot n\text{H}_2\text{O}$ and $\text{Al}_2\text{O}_3 \cdot n\text{H}_2\text{O}$ by means of aq. NH_3 . The ignited ppt. is ground and suspended in EtOH . Thin layers are prepared, and the rate of emission of the α -particles from the U is recorded photographically. A correction for U in the reagents must be determined and applied to the results. Test data for the U in dunite, granite, and kimberlite show that the method is satisfactory. New data for the cores of three ocean bottom sediments obtained from the Cayman Trough between Cuba and Jamaica give U contents of 0.65–1.07 μg . per g. L. S. T.

Determination of small quantities of uranium by fluorescence method. V. Unkovskaja (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 380–383).—Small quantities of U, ranging from 5×10^{-9} g. to 1 μg ., are determined by fusion with NaF and visual comparison of the fluorescence produced by ultraviolet illumination with that of NaF containing known amounts of U. Data are recorded for U contents of natural petroleum ash samples, H_2O from petroleum-bearing beds, and marine deposits. L. J. J.

Application of iodate method to separation and determination of rare elements. T. A. Uspenskaja and J. A. Tschernichov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 800–801).—Zr salts react with KIO_3 to give sparingly sol. $2\text{Zr}(\text{IO}_3)_4 \cdot \text{KIO}_3 \cdot 8\text{H}_2\text{O}$, which can be used in the volumetric determination of Zr. Ta can be extracted quantitatively as an iodate from its oxalate complex. The exact composition of the ppt. is not known, but an empirical factor has been obtained for determining Ta volumetrically by this method. Nb is not pptd. with KIO_3 under the conditions used for pptg. Ta. A. J. M.

Spectrochemical assay of gold ores.—See B., 1941, I, 185.

XI.—APPARATUS ETC.

Calibration of Debye-Scherrer X-ray powder cameras. A. J. C. Wilson and H. Lipson (*Proc. Physical Soc.*, 1941, 53, 245–250).—Since vals. of c for quartz by Bradley and Jay (cf. A., 1933, 891) based on Bergqvist's vals. of a are inconsistent with c determined directly by Elg (cf. A., 1937, I, 436), a and c were determined in terms of the λ scale by two methods with Debye-Scherrer cameras. Results, $a = 4.9032$ and $c = 5.3937\text{Å}$. at 18° , agree closely with Elg's val. of c and the Bradley-Jay val. of c/a , but indicate that Bergqvist's a is low by ~ 1 part in 20,000. A table of angles of reflexion is given for the revised vals. for adoption when quartz is used to calibrate a camera. N. M. B.

Immersion method [for measurement of refractive index of solids]. T. Carpanese (*Z. Krist.*, 1939, 101, 284–289).—A mixed immersion medium containing a non-volatile liquid of high n (CH_2I_2 or $1\text{-C}_{10}\text{H}_{17}\text{Br}$) and a volatile liquid of low n (CHCl_3 , C_6H_6 , CCl_4 , or Et_2O) is employed. The specimen is placed in a glass cell with a plane-parallel bottom of high n and covered with the first liquid; the second liquid is added until the n of the mixture is slightly $<$ that of the specimen. The mixture is allowed to evaporate until the n are equal; the cell is then covered and the n of the liquid determined with a total-reflexion refractometer through the bottom of the cell. A. J. E. W.

Projection comparator-densitometer. H. W. Dietert and J. Schuch (*J. Opt. Soc. Amer.*, 1941, 31, 54–57).—The sample and master spectrograms are projected side by side on a translucent screen, and transmission vals. for individual lines are obtained by means of a slit system in contact with the plate, and a vac. photo-cell. L. J. J.

Photo-electric measurement of the average intensity of fluctuating light sources. J. S. Preston (*J. Sci. Instr.*, 1941, 18, 57–59).—An arrangement for using a smoothing condenser in conjunction with a resistance coupled amplifier and an emission type photo-cell to give accurate averaging for the measurement of the mean intensity of periodically fluctuating light sources is described. A method is given for calculating the capacity necessary in any given case. A. J. M.

Photo-electric turbidimeter. S. Silverman (*Rev. Sci. Instr.*, 1941, 12, 77–78).—The image of a grid, comprising alternate bars and open spaces, the bars and spaces being equal in size, is focussed on another identical grid, which is so adjusted that no light passes through. When a turbid liquid is introduced between the grids, light is scattered and passes through the second grid, its intensity being measured by means of a photo-cell immediately behind the second grid. The instrument is intended primarily for use with very clear liquids and is suitable for counting micellar organisms in aq. solutions, intensity measurements on fluorescent solutions, or for white blood or bacterial counts. J. W. S.

Microphotometer for spectrochemical analysis. E. M. Thorndike (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 66–67).—Apparatus and its operation and performance are described. L. S. T.

Concave grating photo-electric spectrophotometer. C. Sheard and M. N. States (*J. Opt. Soc. Amer.*, 1941, 31, 64–69).—In the instrument described, monochromatic light of any desired λ is obtained from an incandescent or bright-line source by means of a concave grating and slit system, and used in conjunction with a barrier-layer photo-cell giving linear response. L. J. J.

Specifications and testing of spectrochemical apparatus. R. A. Sawyer and H. B. Vincent (*J. Opt. Soc. Amer.*, 1941, 31, 47–53).—Design and testing of optical and photographic equipment for accurate emission and absorption spectrography in industrial conditions are discussed. L. J. J.

Focussing the spectrograph. D. E. Alburger (*Rev. Sci. Instr.*, 1941, 12, 154).—A frame, movable only at right-angles to the spectral lines, and carrying a razor blade in the plane of the emulsion, is substituted for the back and plateholder. By placing the eye close to the focal plane immediately in front of a spectral line and moving the knife edge in from either side, the prism face is darkened evenly only if the line is in focus. A. A. E.

Multi-coloured wax light filter and dissecting chamber holder for microscopes. E. D. Crabb (*Rev. Sci. Instr.*, 1941, 12, 154).—Pellets of Flexowax C, coloured with oil-sol. Glycerol dyes, are compressed in groups between a watch-glass and a glass slip. A. A. E.

Wedge-type p_H colorimeter. A. A. Hirsch (*J. Chem. Educ.*, 1941, 18, 7–9).—The colorimeter is constructed from upright and inverted Erlenmeyer flasks placed in juxtaposition, and is an adaptation of the Bjerrum wedge system. L. S. T.

Ultramicroscope cell. V. Heines (*J. Chem. Educ.*, 1941, 18, 28).—A cell constructed from a discarded motor tyre is described. L. S. T.

Photometric procedure using barrier-layer photo-cells. L. E. Barbrow (*J. Res. Nat. Bur. Stand.*, 1940, 25, 703–710).—The procedure comprises the determination of the illumination-response curve of the cell used and a correction, by means of filters, to yield a spectral response curve simulating the International Committee luminosity curve. To avoid errors due to cell fatigue, readings are always made after such time that the current is a max. The method has been applied to determination of the relative intensities of light sources of various colours and of the transmission factors of coloured filters. J. W. S.

Simplified correction factor for equi-inclination Weissenberg patterns. B. E. Warren and I. Fankuchen (*Rev. Sci. Instr.*, 1941, 12, 90–91).—The correction for the Lorentz polarisation-rotation factor for equi-inclination Weissenberg patterns is derived in terms of the Lorentz polarisation factor for the corresponding equator spot. J. W. S.

Simple and rapid method of adjusting the position of electrode pencils in routine spectrochemical analysis. H. R. Clayton (*J. Sci. Instr.*, 1941, 18, 65).—Modifications to a Gramont arc and spark stand, designed to give more accurate

and rapid adjustment of the position of the electrodes, are described. A. J. M.

Integrating photo-electric meter. J. B. H. Kuper, F. S. Brackett, and M. Eicher (*Rev. Sci. Instr.*, 1941, 12, 87—90).—A robust meter, which operates from a.c. mains and is unaffected by weather conditions, is described. It employs a photo-cell with a very pure Ti cathode of threshold ~ 3160 Å. A condenser and cold cathode "trigger" tube are sealed in an extension of the glass envelope, to eliminate moisture. The small current pulse through the trigger tube is amplified and recorded in a telephone. Curves are given for the erythral radiation received on clear days over periods of 18 months. The spectral response curves of modern Ta and Ti photo-cells are also given. J. W. S.

Optical method for measurement of ultrasonic absorption. E. C. Gregg, jun. (*Rev. Sci. Instr.*, 1941, 12, 149—151).—The voltage applied to a vibrating crystal in liquids to bring the convergence points of parallel light into focus in a microscope at various distances down the beam is measured. Absorption coeffs. (Biquard's α_B) at 1901.5 kc. are: C_6H_6 (22°) 0.032, PhMe (22.5°) 0.0099, $CHCl_3$ (16°) 0.051. A. A. E.

Electron multiplier as an electron counting device. Z. Bay (*Rev. Sci. Instr.*, 1941, 12, 127—133).—The construction of electron multipliers is discussed. A 12-stage multiplier using Ag-Mg electrodes gave a total multiplication of 10^8 for an overall voltage of 3500 v.; thermal emission was negligible and field emission absent. Application to the counting of photons, α - and β -particles, and γ - and X-rays is discussed. A. A. E.

Ionisation amplifier. H. Le Caine and J. H. Waghorne (*Canad. J. Res.*, 1941, 19, A, 21—26).—By the motion of a reed, a charge on the electrode of an ionisation chamber is caused to change an a.c. potential, this change being amplified and used to measure the ionisation current by a condenser balance method. J. W. S.

Wilson chamber. Y. Monteux (*Ann. Acad. Brasil. Sci.*, 1940, 12, 347—348).—A simplified apparatus is described. F. R. G.

Apparatus for the measurement of α -particle range and relative stopping power of gases. M. Y. Colby and T. N. Hatfield (*Rev. Sci. Instr.*, 1941, 12, 62—66).—The apparatus operates on the principle of Naidu's apparatus (A., 1934, 235) for measuring the sp. ionisation with a thin chamber. The collecting electrode comprises a circular Al ring, 4 mm. wide and 22 cm. in diameter, the source being at the centre and the slit made of brass plates so shaped as to give a disc of collimated α -particles. The effective source-electrode distance can be varied by changing the gas pressure in the chamber. The apparatus has been used to measure the relative stopping powers of several gases and the additivity law has been verified for all gases measured, including N_2O (cf. Schmieder, A., 1939, I, 441). J. W. S.

"Magic eye" ionisation gauge. L. N. Ridenour (*Rev. Sci. Instr.*, 1941, 12, 134—136).—The plate microammeter is replaced by a 6E5 tube, which contains a fluorescent screen on which electron bombardment produces a pattern. The grid current in the gauge tube is controlled at a const. val. A. A. E.

Regulated battery-operated high voltage supply. J. G. Barry (*Rev. Sci. Instr.*, 1941, 12, 136—139).—The circuit described can furnish <100 μ a. at >2000 v. It is suitable for making accurate Geiger counter measurements, and for use with portable Ra finders and radioactivity meters. A. A. E.

Light weight high voltage supply for Geiger counters. H. V. Neher and W. H. Pickering (*Rev. Sci. Instr.*, 1941, 12, 140—142).—The instrument (650 g.) gives an output potential of >2000 v.; the power consumption is 0.3—0.5 w., and the power output suffices for 6 counters at 3000 each per min. The output voltage may be stabilised at ± 20 v. with Ne lamps. A. A. E.

Use of the Geiger-Müller counter for small quantities of liquids. H. A. C. McKay (*Rev. Sci. Instr.*, 1941, 12, 103—104).—The liquid is contained in a small stoppered glass cylinder, closed at the base with a thin Cellophane window, of diameter slightly $>$ that of the window of the counter. The assembly of a small counter (natural effect ~ 5 counts per min.) suitable for this purpose is described. J. W. S.

Electron microscope. A. L. G. Rees (*Chem. and Ind.*, 1941, 335—337).—A review of general principles and technique, illustrated by typical photomicrograms. A. J. E. W.

Vacuum-tight sliding seal. R. R. Wilson (*Rev. Sci. Instr.*, 1941, 12, 91—93).—A cylindrical bar or tube slides through a thin piece of sheet rubber in which a hole is cut of diameter \ll that of the bar. The bend in the rubber produced thereby is maintained towards the high-pressure side by a conically-shaped seating through which the bar passes. Suitable gasket dimensions for sealing various sizes of rods are tabulated. The seal permits unlimited translational or rotational motion of the rod. J. W. S.

Interferometric dilatometer with photographic recording. F. C. Nix and D. MacNair (*Rev. Sci. Instr.*, 1941, 12, 66—70).—Three pieces of the material under investigation rest between two optically polished fused SiO_2 discs, and dimensional changes are observed by photographing the interference fringes at frequent intervals. A portion of the lower SiO_2 plate is formed into a wedge, the interference fringes from which serve to indicate temp. changes. Arrangements of the apparatus suitable for use at -195° to 700° are described. Its use is illustrated by measurements of the expansion of quartz in a direction perpendicular to the optical axis. J. W. S.

Abbreviation of the method of least squares. G. J. Cox and (Miss) M. C. Matuschak (*J. Physical Chem.*, 1941, 45, 362—369).—Mathematical. C. R. H.

Theory of the separation of isotopes by thermal or centrifugal methods. A. Bramley (*Science*, 1940, 92, 427—428). L. S. T.

Thermal balance. E. Orosco (*Publ. Inst. Nac. Tecn., Rio de Janeiro*, 1940, 31 pp.).—Apparatus is described for the automatic recording of the rate of reactions which involve a change in wt. due to the liberation or absorption of a gaseous phase, exemplified by data for the dehydration of gypsum; $BaCl_2 \cdot 2H_2O$; $CuSO_4 \cdot 5H_2O$; magnesite alba; schist and bauxite; decomp. of $CaCO_3$ and roasting of coffee (cf. B., 1936, 714). F. R. G.

Rapid method of correcting for inequality of beam arms in the analytical balance. J. C. Williams (*J. Chem. Educ.*, 1941, 18, 38).—The correction curve for loads of 10-, 20-, and 50-g. wts. on each pan is determined, and then the correction (mg.) is added to or subtracted from a given load to convert it into an abs. wt. L. S. T.

Precision of weighing with microchemical balances. (Miss) M. Corner and H. Hunter (*Analyst*, 1941, 66, 149—154).—The performance of one microchemical balance has been examined in detail and the performances of 7 others in less detail. Precision in weighing, i.e., reproducibility, has been found by repeated determinations of one nominal g. wt. against another. Six of the balances showed no certain difference in performance, but two of them, used by students, showed a precision one third of that of the others. The mean precision of a single weighing in routine work, measured by its probable error, is $\sim \pm 3$ μ g. Most of this is due to error in placing the rider. The error introduced into an analytical result by weighing errors alone is not likely to exceed 1% more than once in a 10^3 analyses, but may exceed 0.5% once in ~ 20 analyses, and will exceed 0.1% in 2 out of 3 analyses. These figures refer to a simple analysis in which the result is obtained as a quotient of 2 weighings by difference, and in which both sample and product weigh between 2 and 4 mg. The precision of the microchemical balance is only just sufficient for the purpose for which it is used, and it may be expected to introduce errors from weighing alone comparable with those introduced by the chemical manipulation. L. S. T.

XII.—LECTURE EXPERIMENTS AND HISTORICAL.

Lecture demonstrations. F. B. Dutton (*J. Chem. Educ.*, 1941, 18, 15—17).—Apparatus for demonstrating Boyle's law and heat changes accompanying change of state is described and illustrated. L. S. T.

Bergman, Klaproth, Vauquelin, Wollaston. E. G. Ferguson (*J. Chem. Educ.*, 1941, 18, 3—7). L. S. T.

XIII.—GEOCHEMISTRY.

Distribution of electricity in thunderclouds. (Sir) G. Simpson and G. D. Robinson (*Proc. Roy. Soc.*, 1941, A, 177, 281—329).—Further observations were carried out in the years 1937—1939 on the electric field in eight thunderstorms. In every cloud there is a positive charge of electricity near the top where the temp. is $< -10^{\circ}$. Below this there is a negative charge and generally in this region the temp. is $< 0^{\circ}$. These charges are generated by the collisions of ice crystals in the turbulent ascending air currents in the storm; the ice becomes negatively and the air positively charged. The charges are separated by the sinking of the ice crystals. Below the negative charge there is generally a region containing positive charges and in which the temp. is $> 0^{\circ}$. These lower positive charges are associated with heavy rain and are generated by the breaking of rain drops in ascending currents of air. G. D. P.

Evolution of the atmosphere. J. H. J. Poole (*Sci. Proc. Roy. Dublin Soc.*, 1941, 22, 345—365).—An attempt to calculate the constitution of the atm. from the composition of rocks in the lithosphere and from the amount of igneous rock denuded during geological time indicates that the total free C now buried in sedimentary rock could not have been derived from the CO_2 in the primitive atm. The original liberation of free O_2 is attributed to photo-dissociation of H_2O vapour in the upper atm. at high temp., allowing enough O_2 to be accumulated to start plant life and then produce by the photo-synthetic decomp. of CO_2 the main bulk of atm. free O_2 or that used in the formation of sedimentary rocks. The problems involved are considered quantitatively and the accumulation is shown to accord with accepted views on the existence of terrestrial life. The absence of O_2 and H_2O vapour from the outer atm. of Venus is briefly discussed. N. M. B.

Lithium in the thermal waters of Kazakhstan. I. P. Novochatski and S. K. Kalinin (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 53—54).—The Li content was determined spectroscopically using the 3232.67 Å. line as standard. Dry residues from thermal waters from different thermae contain 0.005—0.1% Li. O. D. S.

Distribution of ozone in the stratosphere: measurements of 1939 and 1940. W. W. Coblentz and R. Stair (*J. Res. Nat. Bur. Stand.*, 1941, 26, 161—174; cf. A., 1939, I, 391).—Further investigations have confirmed the results recorded previously. J. W. S.

Water of the Vretenice spring on the island of Krk. S. Miholić (*Arh. Kemiju*, 1940, 14, 24—26).—The H_2O does not differ from that of other Dalmatian springs, except in its appreciable radioactivity. R. T.

Matijino spring at Ponijevo near Zepče, Bosnia. H. Iveković, L. Dančević, and M. Herrmann (*Arh. Kemiju*, 1940, 14, 21—23).—The H_2O contained Na 0.3072, K 0.0517, Ca 0.3856, Mg 0.4127, Fe 0.0099, NH_4 0.0002, Cl^- 0.2140, SO_4^{--} 0.1979, HCO_3^- 3.5427, NO_3^- 0.00006, H_2SiO_3 0.1115, and CO_2 1.9830 g. per l., in Sept., 1939. R. T.

Palaeochemistry of the ocean. E. J. Conway (*Nature*, 1941, 147, 480).—The original K:Na ratio of the ocean, and oceanic salinity at the beginning of the Cambrian period, are discussed. L. S. T.

Lake deposits. B. M. Jenkin, C. H. Mortimer, and W. Pennington (*Nature*, 1941, 147, 496—500).—The core-sampler and the sampling operation used in the investigation of the deposits of Lake Windermere, the composition of the cores and the org. remains in them, are described. L. S. T.

Geochemical calculations concerning the total mass of sediments in the earth. P. H. Kuenen (*Amer. J. Sci.*, 1941, 239, 161—190; cf. A., 1938, I, 331).—The total amount of all sediments deduced previously is tested by Clark's Na_2O method, and corr. The new val. for the average speed of oceanic deposition is 1 cm. of solid material in 6×10^3 years. The total thickness of sediments, including pore-space, averages 3 km., and the vol., $13 \times 10^8 \text{ km}^3$. The total amount derived from weathering is $8 \times 10^8 \text{ km}^3$, and is divided as follows: continental clay 1.2, sandstone 0.4, limestone 0.3, unweathered volcanic deposits, graywackes, etc. 0.1, red clay 4.4, blue mud 1.1, and Globigerina ooze 0.5, all $\times 10^8 \text{ km}^3$. CaO has been stored up from the Cambrian to the Cretaceous, and is now

being transferred to the deep sea, a process that will produce a CaO famine in $\sim 15 \times 10^7$ years. L. S. T.

Shallowest (Lubbock Co., Texas) meteorite: a new aubrite. W. F. Foshag (*Amer. Min.*, 1940, 25, 779—786).—The meteorite consists of pure enstatite 81, foscrite 5, oligoclase ($\text{Ab}_{83}\text{An}_{17}$) 2, Fe-Ni ($\text{Fe}_{93}\text{Ni}_7$) 9, troilite 1.5 (I), and miscellaneous 1.5%. The silicates are unusually free from Fe. The meteoric material may be the result of crystallisation from a melt, and the Fe-Ni and (I) may be later introductions. L. S. T.

Hysteresis in feebly magnetic sedimentary rocks. A. G. Kalaschnikov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 368—371).—The magnetic susceptibility of a variety of sedimentary rocks has been measured by a torsion balance method, at field strengths (H) up to 1935 oersted. All paramagnetic samples showed a decrease in susceptibility with increasing H , and also remanence and coercivity vals., not correlated with the Fe oxide content. Diamagnetic samples showed decreasing susceptibility with decreasing H , and sometimes change of sign at low H . Vals. of H for saturation in the ferromagnetic components of the samples are 700—800 oersted. L. J. J.

Mineral resources of continental Europe. W. J. Arkell (*Nature*, 1941, 147, 404—407, 443—446).—A summary concerned with minerals of strategic importance. L. S. T.

[Brazilian] kieselguhr (diatomite). S. Fróes Abreu (*Publ. Inst. Nac. Tecn., Rio de Janeiro*, 1939, 70 pp.).—A review of the distribution of kieselguhr in Brazil. Methods of purification, removal of sand, its use in filtration of oils, and its efficiency as a heat insulator are recorded. Vals. of d and composition are given for a no. of samples. F. R. G.

Mineralogy of the Negus and Con mines, Yellowknife, N.W. Territories, Canada. G. C. Ridland (*Econ. Geol.*, 1941, 36, 45—70).—The ore in these Au mines contains much visible Au, and runs \$30—40 to the ton. The lode deposits consist of quartz-carbonate veinlets that follow zones of shearing in pre-Cambrian andesites. The mineralogy, which is described, is complex. Sulphides, arsenides, antimonides, tellurides, and many uncommon minerals, including gudmundite, FeSbS , are present. They indicate intermediate temp. deposition, whilst textures and structures suggest low-pressure deposition. The indicated depths of the deposits point to the future importance of the Yellowknife field as a mining district. L. S. T.

Occurrence of gudmundite. E. Sampson (*Econ. Geol.*, 1941, 36, 175—184; cf. preceding abstract).—Gudmundite (I) is of more widespread occurrence than is generally recognised. Properties of (I) from different localities are summarised. (I) favours heavy sulphide deposits rich in Fe, and in these deposits belongs to a group of minor minerals later than the main sulphides. Pb sulphaantimonides and fahlerz accompany (I). Au vals. may be either high or negligible. L. S. T.

Crystal structure of gudmundite (FeSbS) and its bearing on the existence field of the arsenopyrite structural type. M. J. Buerger (*Z. Krist.*, 1939, 101, 290—316; cf. A., 1937, I, 204, 289; 1938, I, 217; 1940, I, 240).—The structure is conveniently referred to a doubly-primitive ($B2_1/d$) cell containing 8 mols., with a' 10.00, b' 5.93, c' 6.73 Å., β $90^{\circ} 0'$. At. parameters and interdistances, determined by trial and error calculation of intensities, are tabulated. The results confirm that the at. radii in the arsenopyrite group are incompatible with vals. obtained from pyrite group structures; the deviations are examined in detail with reference to the mode of packing, and qual. adjustments of the arsenopyrite parameters are proposed. The field of existence of the arsenopyrite structure and its relation to the cobaltite structure are discussed; the former is favoured for the compound $\text{AB}^{\text{B}}\text{B}''$ if the at. radius ratios $r_{\text{A}}/r_{\text{B}}$ and $r_{\text{B}}/r_{\text{B}}''$ are small. A. J. E. W.

Optical, spectrographic, and radioactivity studies of zircon. J. H. Morgan and M. L. Auer (*Amer. J. Sci.*, 1941, 239, 305—311).—Data on the radioactivity, n , and Hf:Zr and Y:Zr ratios are tabulated for zircons (I) from the Lake Superior district. The malaco shows a radioactivity $>$ that of the normal and hyacinth types, and, in general the hyacinth type $>$ that of the normal. 24 samples of (I) showed (spectrographically) the presence of Zr, Si, Hf, Y, Ce, Pb, Fe, and Ti. Ge is present in 20 of the samples. No relationships between

Y content and radioactivity or between Y and Hf contents are apparent. The variations in physical properties of (I) may be due to breakdown of the crystal lattice by the action of radioactive elements included at the time of crystal formation, and the type of (I) present in a granite may be governed by the [U] in the magma at the time of formation of the crystals of (I). L. S. T.

Theory for the concentration and distribution of copper in the earth's crust. C. H. White (*Econ. Geol.*, 1941, 36, 1—18).—Cu occurs in traces, at least, throughout the entire crust of the earth, but commercial deposits, although found in every type of rock, occur only where the crust has been fractured, fissured, or sheared. As the earth cooled to temp. at which combination of atoms took place, the interaction of physical and chemical forces, particularly gravity and the union of the elements in order of the heats of formation of their compounds, depressed the major parts of Cu, S, and other of the less chemically active heavy metals and their associated anions to a zone below the silicates where they remained until released by fractures in the solid crust. The order in which metals and anions tend to combine during a falling temp., the compositions of the more important hypogene sulphides, and the average chemical compositions of wall rocks and metamorphic minerals are tabulated.

L. S. T.

Chalcocite problem. N. W. Buerger (*Econ. Geol.*, 1941, 36, 19—44).—The solid phases of the system Cu_2S —CuS have been studied by means of a special camera designed to take X-ray photographs of powder samples at elevated temp. The phase diagram (reproduced) shows that the system contains 3 compounds, viz., chalcocite (I) (Cu_2S), digenite (II) (Cu_9S_8), and covellite (CuS), and 4 phases. The X-ray data and the time-temp. curve show that (I) undergoes transformation at 105°; above 105°, the hexagonal basic structure, and below 105°, the orthorhombic superstructure, is stable. No cubic high-temp. phase appears up to at least 300°. The superstructure phase can dissolve up to 8 at.-% CuS, and the basic structure up to 2 at.-%. Below 78°, (II) has the composition Cu_9S_8 , but above 78°, it takes increasing amounts of either Cu_2S or CuS into its composition. When (I) is heated in air it begins to be converted into (II); this may explain certain anomalous results obtained previously.

L. S. T.

High radium content of a Brazilian mineral. J. Costa Ribeiro (*Ann. Acad. Brasil. Sci.*, 1940, 12, 341—346).—Ore from Rio Branco and Conceição (Minas-Gerais) contains 232—273 mg. of Ra per m. ton.

F. R. G.

Metamorphic strata of Carandai (Minas-Gerais). O. H. Leonardos (*Ann. Acad. Brasil. Sci.*, 1940, 12, 243—259).—Analyses of a silurian conglomerate formation from Carandai and a no. of neighbouring strata are recorded and their bearing on the formation of the strata is discussed.

F. R. G.

Kurnakovite, a new borate. M. N. Godlevski (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 638—640).—The analysis and optical and thermal characteristics of kurnakovite, $2\text{MgO} \cdot 3\text{B}_2\text{O}_3 \cdot 13\text{H}_2\text{O}$, are given.

W. R. A.

Native iron of the Timan. I. A. Preobrazhenski (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 634—637).—Slicks from the N. Timan contain grains of Fe which, on spectroscopic analysis, show Mn and Si (lines > average), Cr, Al, and Ti (very weak), and Ni, Ca, and Cu (slight traces).

W. R. A.

Magnetite in sulphide ores. (A) D. Gallagher. (B) J. S. Brown (*Econ. Geol.*, 1941, 36, 95—100, 100).—(A) A comment on previous work (A., 1941, I, 62). Magnetite that appears to be later than the pyrite with which it is associated occurs in a Au-quartz vein of the Lupa Goldfield, Tanganyika.

(B) A correction (cf. A., 1941, I, 62).

L. S. T.

Age of the continental deposits of the eastern slope of the South Urals. K. V. Nikiforova (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 323—324).—Evidence for Tertiary (neogene) rather than Jurassic origin of a no. of patches of Continental deposits is summarised.

L. J. J.

Devonian and crystalline rocks in the western regions of the Bashkir A.S.S.R. V. A. Balaev (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 320—322).—Granites belonging to the base of the Central Russian platform, found at a depth of

1589 m. in the Tuymaza district, are described. The granites belong to the pre-Cambrian base of the platform. Marine sedimentary formations in the eastern Central Russian platform date from the second half of the Middle Devonian. The bearing of these observations on the distribution of oil-bearing deposits is indicated.

L. J. J.

Titanovesuvianite from the Perovskite mine in the Chuvash mountains, South Urals. L. L. Schilin (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 325—327).—Crystallographic data are given for a new variety of vesuvianite containing 4.59% TiO_2 .

L. J. J.

Alteration product of abukumalite. S. Hata (*Bull. Inst. Phys. Chem. Res. Japan*, 1941, 20, 41—43).—Analyses of the weathered outer shell of abukumalite (I) from Iisaka, Fukushima Pref., and of the wholly disintegrated mineral indicate accumulation of ThO_2 , Fe_2O_3 , and Ce_2O_3 and diminution of CaO , MnO , and Y_2O_3 in the weathered product. (I) probably exists in Hagata pegmatite.

W. R. A.

Rôle of fluorine in phosphate deposition. G. R. Mansfield (*Amer. J. Sci.*, 1940, 238, 863—879).—F is an essential constituent of phosphate rock, and tends to keep it relatively insol.; F is suggested as the agent by which phosphate deposits have been preserved through successive geological ages. Volcanism, as a source of F, may have been an indirect but determinative factor in the origin of the principal phosphate deposits of the U.S.A.

L. S. T.

Fluorite and celestite in the Kungurian deposits of the Ural-Emba region. V. P. Baturin (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 827—828).—The fluorite in these deposits is secondary in origin. Similarity with the composition of rocks of the Zamiatin salt-dome points to a secondary transference of F and Sr in this case too, resulting in a high concn. of these elements in the carbonates of this dome.

A. J. M.

Re-definition of tellurobismuthite and vandiestite. C. Frondel (*Amer. J. Sci.*, 1940, 238, 880—888).—Tellurobismuthite (I), Bi_2Te_3 , is a distinct species and not a variety of tetradymite (II). (I) from Whitehorn, Colorado, has a_c 4.38, c_0 30.6, a_{rel} 10.51 Å., and α 24° 2'. In (I) layers of Te atoms take the place of layers of S atoms in (II). Etch reactions for (I), (II), gruenlingite, and joesite are tabulated. Five new localities for (I) are recorded. X-Ray powder photographs and a new chemical analysis [F. A. Gonyer] show that vandiestite is a mixture of (I) and hessite.

L. S. T.

Crystal structure of violarite. F. A. Bannister (*Min. Mag.*, 1941, 26, 16—18).—Chemical analysis by Short and Shannon (A., 1930, 1551) showed that violarite has the formula $(\text{Ni}, \text{Fe})_3\text{S}_4$ and is not, as Lindgren (1924) suggested, a mixture of pentlandite and NiS_2 . This is confirmed by X-ray examination of material from Sudbury, Ontario, which showed a face-centred cubic (spinel) structure with edge 9.51 Å. Material from Sudbury had previously been considered to be polydymite, but violarite differs from this in containing much Fe, in the absence of twinning, and in the violet colour on polished sections. Linnaeite from Müsen, Westphalia, and the original polydymite from Grûneau mine, Rhineland, both have the same type of structure, with a 9.40 and 9.47 Å., respectively.

L. J. S.

Optical properties of olivines from Ubekend Island, west Greenland. P. M. Game (*Min. Mag.*, 1941, 26, 11—15).—Measurements of n (β 1.666—1.690) and the optic axial angle ($2V$ 87.5—89.75°) were made of olivines from a thick series of lavas and from dykes. The data indicate that in any one rock there may be a max. variation of 9 mol.-% Fe_2SiO_4 . The relative merits of β and $2V$ as guides to the chemical composition are discussed.

L. J. S.

Selenium and tellurium contents of sulphur from Krisuvik, Iceland. J. N. Friend and J. P. Allchin (*Min. Mag.*, 1941, 26, 9—10).—The crude mineral (a), extracted S (by CS_2) (b), and insol. residue (c) contained Se, Te, and Ti, respectively: (a) 18.9, 378, 120; (b) 12.5, 250, —; (c) 200, 4000, 3750 p.p.m. Ni, Fe, Ca, and Ba are also present in (c).

L. J. S.

Sulphatic cancrinite and analcime from Loch Borolan, Assynt. F. H. Stewart (*Min. Mag.*, 1941, 26, 1—8).—Large cleavable masses of blue sulphatic cancrinite occur in pegmatite veins in borolanite. Analysis gave SiO_2 34.76, Al_2O_3 30.81, CaO 3.87, SrO 0.32, Na_2O 18.90, K_2O 1.29, CO_2 1.90, SO_3 5.93, $\text{H}_2\text{O} + 2.30$, $\text{H}_2\text{O} - 0.20$, total 100.28; d 2.42,

ω 1.502, ϵ 1.497. The mineral is isomorphous with cancrinite with SO_3 replacing CO_2 , and in the series the ordinary refractive index (ω) and the birefringence decrease with increase of SO_3 . Analcaline gave SiO_2 52.89, Al_2O_3 24.63, CaO 0.19, Na_2O 13.31, K_2O 0.73, $\text{H}_2\text{O} + 7.66$, $\text{H}_2\text{O} - 0.29$, total 99.70; d 2.268, n 1.486—1.488. It shows optical anomalies and is compared with the eudnophite from Norway. L. J. S.

Felspars from Schwanberg (Styria). L. Dolar-Mantuani and S. Koritnig (*Z. Krist.*, 1939, 101, 30—38).—Detailed optical data are given for felspars and plagioclase from a marble deposit penetrated by aplite; the felspars resemble those from the neighbouring Pohorje mountains. A Schwanberg felspar (d 2.557) contained SiO_2 63.60, Al_2O_3 19.68, CaO 1.62, Na_2O 2.82, K_2O 11.92, $\text{H}_2\text{O} + 0.40\%$, with traces of Fe_2O_3 and MgO , corresponding with the composition $\text{Or}_{70}\text{Ab}_{28}\text{An}_6$. A. J. E. W.

Liquid inclusions as the cause of imaginary pelitisation of felspars. D. S. Korshinski (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 112—114).—Microscopical examination of a large no. of rock samples leads to the conclusion that in a large majority turbidity is due to small liquid inclusions. These inclusions may be evenly dispersed or may lie along concealed cracks; gas bubbles are absent. Turbidity in felspars is associated with incomplete change, in consequence of which defects in the crystal lattice are present; these then become filled with liquid. Similar liquid inclusions, often erroneously described as pelitic, occur in other minerals, especially in micas, carbonates, zeolites, quartz, prenite, and gypsum. F. L. U.

Spectrographic study of Central American and Asiatic jades. D. Norman and W. W. A. Johnson (*J. Opt. Soc. Amer.*, 1941, 31, 85—86).—Specimens of jade from Maya objects and from Asiatic sources were analysed spectrographically in a C arc. The differences are wholly mineralogical, no major differences in composition being found. L. J. J.

X-Ray study of the carnallite-bromocarnallite mixed-crystal series. K. R. Andress and O. Saffé (*Z. Krist.*, 1939, 101, 451—460).—From oscillation X-radiograms, the tetragonal $\text{KMg}(\text{H}_2\text{O})_6\text{Cl}_2 \cdot \text{KMg}(\text{H}_2\text{O})_6\text{Br}_2$ mixed-crystals, in which Br forms 20.4—74.7 (p) at.-% of the total halogen, have a 13.302—13.519 ± 0.004 , c 6.685—6.775 ± 0.002 Å.; ρ 1.7030—2.0118 ± 0.0005 ; 4 mols. in unit cell; space-group C_{2h}^2 — $P4/n$. At. parameters are determined from space-filling and charge-distribution considerations, and by calculation of intensities; the structure is closely related to that of perovskite. Statistical distribution of Cl and Br atoms is confirmed. The a and c vals. rise abruptly between $p = 45$ and 67, and with $p > 67$ the X-radiograms indicate a higher degree of symmetry (apparent space-group D_{2h}^{10} — $P4/mmm$). These anomalies are ascribed to a new type of isomorphism, in which changes in the hydration energy relationships cause a rearrangement of the H_2O mol. orientations. $\text{KMg}(\text{H}_2\text{O})_6\text{Cl}_2$ is rhombic-pseudohexagonal, with a 9.54, b 16.02, c 22.52 Å.; ρ 1.602; 12 mols. in unit cell; space-group V_{2h}^2 — $Pban$. $\text{KMg}(\text{H}_2\text{O})_6\text{Br}_2$, $\text{RbMg}(\text{H}_2\text{O})_6\text{Cl}_2$, and $\text{NH}_4\text{Mg}(\text{H}_2\text{O})_6\text{Cl}_2$, respectively, are weakly monoclinic, with a 13.59, 13.30, 13.30; b 6.79, 6.65, 6.66; c 6.80, 6.62, 6.68 Å.; ρ 2.134, 1.79, 1.46; 2 mols. per unit cell. A. J. E. W.

Crystal structure of valleriite. J. E. Hiller (*Z. Krist.*, 1939, 101, 425—434).—An original specimen of valleriite (cf. Ramdohr and Ödman, *Geol. Fören. Stockholm Förh.*, 1922, No. 54) contains Cu 18.67, Fe 21.47, S 22.31, Al_2O_3 6.09, MgO 17.87, CaO 0.93, MnO 0.10, SiO_2 1.75, H_2O 12.16% [analysis by (Frl.) Bendig]. From powder X-radiograms, the rhombic-pseudohexagonal crystals have a 6.13, b 9.81, c 11.40 Å.; ρ 3.09; 2 mols. in unit cell; space-group D_{2h}^{10} . Cleavage and optical data indicate a layer lattice. At. parameters are derived by analogy with MoS_2 , and confirmed by calc. intensities; the min. interat. distances are Fe—Fe 2.26, Cu—Cu 2.72, Fe—S 2.19, Cu—S 2.43 Å. The structural analysis is based on the formula $\text{Cu}_2\text{Fe}_4\text{S}_7$, but the proposed structure contains spaces which may be filled by Mg; the formula $\text{Cu}_2\text{Fe}_3\text{S}_7\text{Mg}(\text{OH})_2$ gives a better Z val. (1.98) than $\text{Cu}_2\text{Fe}_4\text{S}_7$ (2.23). $\text{Cu}_2\text{Fe}_4\text{S}_7$ is unlikely as the at. radii correspond with Cu^I and Fe^{III} . A. J. E. W.

Structure of manganese leonite. H. Anspach (*Z. Krist.*, 1939, 101, 39—77).—Schiebold oscillation photographs show that the doubly primitive monoclinic unit cell, containing

four $\text{K}_2\text{Mn}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$ (I) mols., has a_0 11.986, b_0 9.57, c_0 9.95 Å., β (crystallographic) 85° ; ρ 2.313; space-group C_{2h}^2 . Complete at. parameters are reduced from Patterson and Fourier analyses giving projections on (001), (100), and (010). The arrangement of K, Mn, and S atoms resembles that in Tutton's salts (cf. A., 1935, 415, 1001) and alums, the Mn atoms forming a completely filled cubic face-centred lattice; a comparison of the structures of these salts shows increasing distortion of the octahedral disposition of M^I atoms around M^{II} (or M^{III}) with decreasing hydration, but the tetrahedral arrangement of M^I around the S atoms is maintained. The H_2O mols. of (I) form complex $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ ions which occur as rectangles perpendicular to the plane of symmetry. The proposed structure is in accord with Pauling's electro-neutrality rule and with crystallographic data. A. J. E. W.

"Isomorphism" of monazite and crocoite. S. von Gliszczynski (*Z. Krist.*, 1939, 101, 1—16).—Monazite is more closely related crystallographically to xenotime than to crocoite, with which it is isotypical but not truly isomorphous. Rotation photographs of a Perdatsh turnerite give a_0 6.782, b_0 6.993, c_0 6.455 Å., β $76^\circ 22'1''$; 4 mols. per cell; ρ calc. 5.217: a crocoite from Beresowsk (Urals) has a_0 7.108, b_0 7.410, c_0 6.771 Å., β $77^\circ 33'$; 4 mols. per cell; $\rho_{\text{calc.}}$ 6.107. Both minerals have the space-group C_{2h}^2 , and a structural similarity is confirmed by powder X-radiograms; some specimens of monazite, however, give a different diagram showing a similarity to xenotime. This may be due to isomorphous mixtures of CePO_4 and YPO_4 , but it is more probable that monazites of magmatic origin have had a deformed xenotime structure which has undergone slow and sometimes incomplete transformation into a structure of the turnerite type; turnerite, originally formed at lower temp., has retained its structure unchanged. Monazite may act as a "geological thermometer." A. J. E. W.

Magnetic studies on braunite, $3\text{Mn}_2\text{O}_3 \cdot \text{MnSiO}_3$. K. S. Krishnan and S. Banerjee (*Z. Krist.*, 1939, 101, 507—511).—A specimen of braunite (Mn 54, Fe^{II} 1.2%) has $\chi = 145.5 \times 10^{-6}$ c.g.s. units at 301.8 — 668.1°K ; the Curie temp. is 70°K , the Curie const. 0.0327, and the effective magnetic moment 5.1 Bohr magnetons. If χ_I and χ_{II} are the susceptibility vals. perpendicular and parallel to the tetragonal axis, $\chi_I - \chi_{II} = 0.364 \times 10^{-6}$ at 300.8°K ; more than half of this val. is attributed to Fe. The low anisotropy supports the constitution $3\text{MnMnO}_3 \cdot \text{MnSiO}_3$ for braunite. A. J. E. W.

Minerals of the descloizite group. Konichalcite, staszite, austinite, dufite, aräoxene, volborthite, pyrobelonite. H. Strunz (*Z. Krist.*, 1939, 101, 496—506).—Powder and rotation X-radiograms show that the following two groups of minerals form isodimorphous series which are related to each other by "internal twinning": (a) (monoclinic); tilasite, durangite, crypholite; (b) (rhombic); adelite, austinite, higginsite (a_0 5.84, b_0 9.21, c_0 7.42 Å.; 4 mols. in unit cell; $\rho_{\text{calc.}}$ 4.294; $\rho_{\text{obs.}}$ 4.33) (konichalcite, staszite), dufite, aräoxene, volborthite (calciovolborthite, tangeite), descloizite (dechenite, psittacinite, chileite, eusynchite), mottramite, pyrobelonite (a_0 6.22, b_0 9.57, c_0 7.56 Å.). Brackebuschite has a different structure. Names of other varieties or structurally identical minerals are added in parentheses. A. J. E. W.

Chemical study of silicates. IX. Transformation of tremolite into diopside on heating. E. Thilo (*Z. Krist.*, 1939, 101, 345—350).—Rotation photographs show that the transformation of tremolite into MgSiO_3 -diopside mixed crystals and SiO_2 (cf. Posnjak and Bowen, A., 1931, 1146), at 1100° , occurs by the mechanism proposed previously for the anthophyllite-enstatite transformation (cf. A., 1939, 1, 287). The Si—O chains in tremolite retain their direction in the resulting mixed crystals. The SiO_2 is formed as completely disordered particles of cristobalite. A. J. E. W.

Composition of jarosites from the deposits of Central Kazakhstan. F. V. Tschuchrov, R. E. Arest-Jakubovitch, and H. A. Kozlova (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 829—831).—Jarosites have usually been formed by the weathering of pyrites, or from marcasite or pyrrhotite. Analyses of 10 samples are given, among which Na jarosites predominate. P, Al, and Ca are present in all samples, and Mg is absent, or occurs only in traces. Se occurs in certain samples, whilst spectroscopic traces of V, Ga, In, Mo, Sn, and Ag were detected. A. J. M.

Distribution of metal values in ore deposits. N. K. Razumovskii (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 814—816).—The arithmetic mean of ore samplings does not correctly characterise the deposit. A better val. is the geometric mean. The distribution of Au in a no. of samples is logarithmic, and the same law was found to apply to Cu, Pb, and Zn ores from a given deposit. A. J. M.

Chlorine and bromine in massive crystalline rocks. L. S. Selivanov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 809—813).—The mean Br content of 23 rocks was $1.62 \times 10^{-4}\%$, and the Cl content $3.14 \times 10^{-2}\%$. Various types of rocks differ very little in their Cl and Br content. The most acid and the most basic rocks contain somewhat less Br than the intermediate ones. The ratio Cl:Br varies considerably, the average being 243. This ratio is markedly lower for basic than for acidic rocks. Soils contain an average of $6.51 \times 10^{-4}\%$ and peats $3.1 \times 10^{-3}\%$ of Br, so that the Br content of soils is at least 4 times and of peats 20 times that of rocks. Almost all this Br in soils and peats is combined in org. compounds. The Cl content of soils is approx. the same as that of rocks. The ratio Cl:Br in sea- H_2O is $>$ that in rocks. This cannot be accounted for by weathering of rocks, and is probably due to the preponderance of Cl_2 and chlorides in volcanic gases, which become dissolved in the sea. A. J. M.

Possible type of cassiterite mineralisation in the near-polar Urals. S. G. Sarkisian (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 807—808).—Investigation of loose sedimentary deposits of certain rivers in the N. Urals shows the presence of scheelite, Au, and cassiterite. The last is accompanied by sulphides (pyrites, chalcopyrite, arsenopyrite), and is sometimes found as an intergrowth with sulphides. It may therefore be assumed that the formation of cassiterite-bearing loose deposits is connected with the decay of a primary Sn mineralisation of the sulphide type. A. J. M.

Isotopic composition of cuprite oxygen. W. H. Hall and C. Hochanadel (*J. Amer. Chem. Soc.*, 1940, 62, 3259—3260).—Cuprite (I) was reduced by electrolytic H_2 and ρ of H_2O formed was compared with ρ of H_2O formed from H_2 and atm. O_2 . Vals. of ρ were determined by a buoyancy balance method in which temp. was the observed variable. The H_2O from (I) had a flotation temp. $0.021^\circ <$ that of H_2O from O_2 , indicating that the contribution of the O of (I) to the ρ of the H_2O formed is 5.5 p.p.m. $<$ that of atm. O_2 . The isotopic composition of O of (I) is approx. the same as that of ordinary H_2O . W. R. A.

Alkaline province in the northern part of central Siberia. G. Moor (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 225—229).—Various rocks from this region are described and discussed. J. W. S.

Killough-Ardglass dyke swarm. S. I. Tomkeieff and C. E. Marshall (*Quart. J. Geol. Soc.*, 1940, 96, 321—338).—Petrological. Chemical analyses of the lamprophyre and Tertiary dykes, and mineral analyses are recorded. L. S. T.

Borrowdale volcanic series of Coniston, Lancashire. G. H. Mitchell (*Quart. J. Geol. Soc.*, 1940, 96, 301—319).—Stratigraphical. L. S. T.

Carboniferous limestone of the Castleton-Bradwell Area, North Derbyshire. J. Shirley and E. L. Horsfield (*Quart. J. Geol. Soc.*, 1940, 96, 271—299). L. S. T.

Sodium bicarbonate (nahcolite) from Searles Lake, California. W. F. Foshag (*Amer. Min.*, 1940, 25, 769—778).— $NaHCO_3$, occurring in monoclinic crystals and twins chiefly in a gaylussite marl, has been found in large amounts in a well core drilled below the central salt crust of Searles Lake. Its crystallography, physical and optical properties, and paragenesis are discussed. $NaHCO_3$ may have been formed by the interaction of trona and $Ca(HCO_3)_2$ solutions. L. S. T.

Lamprobolite, a new name for basaltic hornblende. A. F. Rogers (*Amer. Min.*, 1940, 25, 826—828).—The amphibolite with high Fe^{III} content and high vals. of n , and called basaltic hornblende, basaltine, oxyhornblende, etc., is best named lamprobolite. L. S. T.

Effect of adsorbed substances—hardness (or strength) reducers—on the mechanical strength of quartz sediments in

water. P. Reh binder and J. B. Aron (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 802—806).—The adsorption of certain electrolytes by rock surfaces greatly reduces their hardness, and facilitates drilling. This phenomenon has been investigated by finding the mechanical strength of suspensions of the rock in H_2O , or a solution of an electrolyte, after compression around a screwed Al rod, by centrifuging. The max. stress necessary to tear the rod from the sediment was determined. There is a very marked decrease in the strength of the sediment when very small quantities of hardness reducers ($NaCl$, $MgCl_2$, $AlCl_3$) are added to the H_2O in which a pure quartz sediment is formed. The decrease is the more effective the greater is the valency of the cation. Sucrose also causes a decrease in strength. The theory is that adsorption decreases the cohesion between particles. The thickest liquid film between grains, and hence the greatest looseness of sediment, occurs when there is the smallest coagulation effect, and thus the process is related to peptisation. Further increase in the concn. of electrolyte leads to a decrease in the thickness of the adsorbed film, with consequent increase in strength. A. J. M.

Vanadium in oil products and bituminous rocks. G. G. Bergman (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 108—111).—Results of the analysis of a no. of oils, oil products, and associated rocks for V are recorded. The ash of one oil examined contained $>12\%$ V. F. L. U.

Quantitative X-ray study of soils. J. C. L. Favejee (*Z. Krist.*, 1939, 101, 259—270).—A method of analysis of powders is outlined in which the relative proportions of the constituents are determined by comparison of their Debye-Scherrer line intensities with those given by mixtures of known composition; the intensities are not accurately \propto the percentages of the constituents. The line intensities are estimated by direct reference to the intensity of the primary X-ray beam. The method is used to determine quartz, muscovite, kaolinite, and montmorillonite in the clay fractions of certain Dutch soils. Large deficits in the total clay content are obtained; these are ascribed to particle size effects, and show that the particle sizes in the specimen and reference mixture must be controlled within narrow limits. A. J. E. W.

Vanadium and nickel in coal from the upper Silurian strata of the Alai and Turkestan mountains. A. L. Vorobiev (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 28, 250—251).—Shale samples from coal seams in the Alai and Turkestan mountains contain NiO 0.039—0.07% and V 0.03—0.12%. Ash from various samples of coal from these regions contains NiO 0.00—1.40% and V_2O_5 0.00—1.30%. J. W. S.

Mineral content of Bevier coal seam, Boone County, Missouri. T. R. Gallacher (*Mines Mag., Denver, Colorado*, 1940, 30, 586—590, 611—612).—The minerals were deposited in a definite order as follows: syngenetic minerals (I) (marcasite and/or pyrite); pene-contemporaneous minerals (concretionary pyrite); epigenetic minerals (transparent scaly calcite, gypsum, transparent scaly calcite, pyrite, sphalerite, fibrous calcite). The (I) were doubtless controlled by the character of the original swamp solutions. The subsequent periods of mineralisation were related to solutions derived from over- or under-lying formations, to the chemical changes produced by interaction with minerals in the coal, or to mingling with O-bearing solutions. R. B. C.

Older and more recent [German] brown coals. W. Gothan (*Braunkohle*, 1941, 40, 37—40).—Peat-bog formation occurred in the older Eocene brown coals even under tropical conditions and was not exceeded in intensity by that in the more recent (Lower Miocene) coals. Peat-bog formation occurred formerly and occurs at present in the tropics to a very small extent. The higher bitumen content of the older brown coals is probably due to the presence among tropical plants of more numerous sources of resin, wax, and oil than occur in temperate climates. It can be assumed that this was true formerly. The formation of coking coal was probably favoured by the heat of the tropical climate in the case of the older brown coals inasmuch as the oxidisable humic substances were more abundant and more easily decomposed than in the cooler Miocene climate. R. B. C.

BRITISH CHEMICAL AND PHYSIOLOGICAL ABSTRACTS

A., I.—General, Physical, and Inorganic Chemistry

JULY, 1941.

I.—SUB-ATOMICS.

Extreme ultra-violet spectra of Ne iv, v, vi. F. W. Paul and H. D. Polster (*Physical Rev.*, 1941, [ii], 59, 424—430).—An electrical discharge for the excitation of high stages of ionisation in gases was developed (cf. A., 1940, I, 49), and was used to excite Ne. Spectrograms of the discharge from 96 to 1010 Å. were taken with a 3-m. grazing-incidence vac. spectrograph. Data for 117 lines of Ne iv, 56 of Ne v, and 25 of Ne vi are tabulated. Calc. ionisation potentials, respectively, are 96.43, 125.8, and (estimated) 157 v.

N. M. B.

Radiative X-ray transitions within the L shell. D. H. Tomboularian and W. M. Cady (*Physical Rev.*, 1941, [ii], 59, 422—423; cf. A., 1941, I, 185).—Isolated lines of Na (375 Å.), Mg (317 Å.), and Al (290 Å.) reported by Skinner (cf. A., 1941, I, 21) are identified as L_{II} — L_{III} . Hence the L_I term of these elements is evaluated and predictions of L_I for Si—Cr are made.

N. M. B.

Photovoltaic effect. H. M. Cassel (*J. Chem. Physics*, 1941, 9, 377).—Introduction of the quantum rule that the transfer of electrons is impossible if there are no vacant energy levels to which the electrons can be transferred causes the term hI of the equation of Fink and Adler (cf. B., 1941, I, 118) to be substituted by $a_{ads}^* hI$, where a_{ads}^* is the activity of the adsorbed positive ions as obtaining under the influence of light. With this correction the theory covers the whole range of the empirical light intensity—potential curve.

J. W. S.

Emission of secondary electrons from nickel. R. M. Chaudri and A. W. Khan (*Phil. Mag.*, 1941, [vii], 31, 382—393).—The secondary electron emission from Ni produced by primary electrons of energy 100—4000 v., incident at 45—50°, has been investigated. The general character of the secondary emission curves is unaltered by degassing the Ni surface, but for a degassed surface the max. val. of the secondary emission coeff. falls to 1.58, the corresponding primary electron energy being ~600 v. The coeff. decreases exponentially for primary energies >600 v.

A. J. M.

Influence of a longitudinal magnetic field on an electrical discharge in mercury vapour at low pressure. C. S. Cummings and L. Tonks (*Physical Rev.*, 1941, [ii], 59, 514—522; cf. A., 1939, I, 545).—The absence of a constricting effect in a uniform longitudinal magnetic field was confirmed. "Abnormal" electron distributions were transmitted with decreasing amplitude along the arc in the direction of the anode, and obeyed a modified Boltzmann distribution in accordance with the theory of an arc in a longitudinal field.

N. M. B.

Transmission of an electron density disturbance along a positive column in a longitudinal field. L. Tonks (*Physical Rev.*, 1941, [ii], 59, 522—527; cf. preceding abstract).—Mathematical. A longitudinal magnetic field slows down the recovery of a normal distribution of ions and electrons (following a disturbance in the column) by decreasing the radial mobility of the electrons. A theory for the approach to normal, after a cylindrically symmetrical disturbance, is developed and compared with experiment.

N. M. B.

New mass spectrograph and the isotopic constitution of nickel. H. A. Straus (*Physical Rev.*, 1941, [ii], 59, 430—433).—A new double-focussing mass spectrograph with 90° electric field and 60° magnetic field is described. Vals. obtained for the % isotopic constitution of Ni are ^{58}Ni 62.8, ^{60}Ni 29.5, ^{61}Ni 1.7, ^{62}Ni 4.7, and ^{64}Ni 1.3. With the isotopic

wt.s. of Okuda (cf. A., 1941, I, 93) the chemical at. wt. is 58.84.

N. M. B.

Simultaneous emission of particles and pair production. S. de Benedetti (*Physical Rev.*, 1941, [ii], 59, 463).—In view of discrepancies between theory and experiments, either with cloud chambers or with counters, on pair production by radioactive substances, coincidence counter studies of simultaneous emission of charged particles are summarised and discussed.

N. M. B.

Deposition of atmospheric radioactivity on objects exposed to air streams. S. Freed and M. L. Schultz (*J. Franklin Inst.*, 1941, 231, 345—355).—When air was blown against various substances (glass, mica, Cu, brass, steel, and Al, but not Pb) a radioactive material was deposited on them, which has been identified as the products of decay of Rn and thoron. The radioactive nuclei were uncharged. After rain or snow the deposit was considerably reduced. O_2 from cylinders also gave the deposit, but the amount varied with the time during which the gas had been compressed. N_2 , H_2 , and CO_2 from cylinders did not give the deposit. After N_2 had been directed against an Al surface for 45 min. no deposit from air could be detected on the surface until several hr. had elapsed. The relative concn. of uncharged radioactive condensation nuclei has been calc. to be 89% of the total no. of radioactive nuclei in the atm.

A. J. M.

Relative efficiencies of radioactive neutron sources. E. J. Murphy, W. C. Bright, M. D. Whitaker, S. A. Korff, and E. T. Clarke (*J. Franklin Inst.*, 1941, 231, 357—371).—The efficiencies of Ra-Be and Rn-Be neutron sources have been compared, the following factors being considered: total amount of Be in the source, the geometrical shape of the source, the effect of impure Be, the effect of empty space in the containing bulb, and the contribution of photo-emitted neutrons to the total no. measured. Rn sources may vary considerably in efficiency, but Ra sources seldom vary by >15%. For Ra sources, the size of the Ra grains and the purity of the Be are important, and the degree of mixing especially so. The geometrical shape of the source and the amount of Be are not important. In addition, for Rn sources, the container should be as full as possible.

A. J. M.

Continuous X-rays excited by the β -particles of ^{32}P . (Miss) C. S. Wu (*Physical Rev.*, 1941, [ii], 59, 481—488).—The internal and external X-rays excited by the β -particles of ^{32}P were investigated by means of a CCl_2F_2 -filled ionisation chamber. The intensity of the internal X-rays excited by the disintegration electrons when leaving the nucleus was ~0.25 that of external X-rays excited by completely stopping the electrons in Al. The respective estimated total energies of the X-rays are ~0.0020 mc^2 per disintegration electron, and ~0.0082 mc^2 , in good agreement with theory. The relation between the intensity of the external X-rays excited by completely stopping electrons in Pb, W, Sn, Ag, Mo, Cu, Fe, Al, C, and Be and the at. no. Z was found to be in fairly good agreement with the curve from Bloch's formula for electron energy loss by inelastic collisions and with the Bethe-Heitler theory that intensity $\propto Z^2$. The spectral distribution of the external X-rays is independent of Z and is approx. the same as that of the internal X-rays.

N. M. B.

Interaction experiments with resonance neutrons. H. B. Hanstein (*Physical Rev.*, 1941, [ii], 59, 489—497).—With a cyclotron and slow-neutron collimator, precision transmission measurements were made for resonance neutrons of In (~0.9 e.v.) and I (25—100 e.v.), and for the Cd absorption

group (thermal energy). Data are reported for In resonance neutrons and cross-section measurements for H, D, C, Al, Fe, Ni, Cu, Zn, Sn, Pb, and Bi, interference effects, neutron-proton and neutron-deuteron interactions and comparison with thermal neutrons, and neutron-proton interaction for I resonance neutrons. Results indicate a free neutron-proton cross-section of 21×10^{-24} compared with the theoretical 14×10^{-24} sq. cm. N. M. B.

Pair production in the field of an electron. K. Shinohara and M. Hatoyama (*Physical Rev.*, 1941, [ii], 59, 461).—A photograph obtained during the study of γ -rays from F bombarded with protons shows three tracks, two negative and one positive, starting from a point in the gas-filled cloud chamber. The energies are: positron 2.38, electrons 2.38 and 0.17 Me.v., giving 5.95 Me.v. for the energy of the incoming photon. This val. ($\pm 2\%$ error) agrees with available data for the energy of γ -rays from F + p. N. M. B.

Absolute number of quanta from the bombardment of fluorine with protons. J. A. Van Allen and N. M. Smith, jun. (*Physical Rev.*, 1941, [ii], 59, 501—508).—With a special variable-pressure absorption-cell ionisation chamber to facilitate clear distinction between the short-range α -particles and the scattered protons, the angular distribution and total yield of α -particles at the lowest resonance (330 kv.) were determined. Results show that to within 2% the angular distribution of the α -particles is spherically symmetric and that the yield over 4π steradians is $8.9 \pm 0.5 \times 10^4$ α -particles per μ -coulomb of 360-kv. protons bombarding a thick CaF_2 crystal. The abs. no. of quanta from the reaction is presumably the same. The ratio of the γ -ray intensity at 1050 to that at 370 kv. is 42.0 ± 0.8 . Thus the γ -ray intensity at 1050-kv. bombarding voltage is $3.74 \pm 0.2 \times 10^6$ quanta per μ -coulomb of protons on CaF_2 . The angular distribution of γ -rays is spherically symmetric to 5%. N. M. B.

Concentration method for certain radioactive metals. J. Steigman (*Physical Rev.*, 1941, [ii], 59, 498—501).—The Szilard-Chalmers concn. technique is extended to the separation of a non-active from an active isotope formed in nuclear transformations. The principle involved is the choice of certain metal complex compounds which are highly stable and which have also been resolved into stable optical isomerides. The technique is applied to Co, Ir, Rh, and Pt complex salts, with resulting high concn. ratios. N. M. B.

Cosmic rays: recent developments. P. M. S. Blackett (*Proc. Physical Soc.*, 1941, 53, 203—213).—Guthrie lecture, 1940. N. M. B.

Direct measurement of the mass of the mesotron. L. Leprince-Ringuet, S. Gorodetzky, E. Nagcotte, and R. Richard-Foy (*Physical Rev.*, 1941, [ii], 59, 460—461).—A stereoscopic cloud-chamber photograph of the elastic collision of a cosmic-ray mesotron with an electron was obtained such that conditions favoured precision measurement of all necessary quantities. The val. found for the rest mass of the mesotron is $(240 \pm 20)m_0$. A detailed discussion is given. N. M. B.

Soft component and decay of mesotrons at 3000 m. N. Fedorenko (*Physical Rev.*, 1941, [ii], 59, 461).—The ratio soft/hard component is found to be independent of zenith angle, indicating mutual equilibrium of the components. The ratio increases 1.33 times from sea level to 3000 m. Results indicate that electrons take only 50% of the decay energy of mesotrons, the remainder going probably to neutrinos. Mean mesotron life is 2.5μ -sec. N. M. B.

Interaction of γ -rays with mesotrons. R. F. Christy and S. Kusaka (*Physical Rev.*, 1941, [ii], 59, 405—414; cf. Oppenheimer, A., 1940, I, 143).—Mathematical. Integrated cross-sections in the limit where mesotron and photon energies are large compared with mesotron rest energy are calc. for the production of a mesotron pair by a γ -ray and for the bremsstrahlung of a mesotron in the electromagnetic field of a nucleus. N. M. B.

Burst production by mesotrons. R. F. Christy and S. Kusaka (*Physical Rev.*, 1941, [ii], 59, 414—421; cf. preceding abstract).—Mathematical. On the assumption that, under great absorbing thicknesses, cosmic-ray bursts are cascade showers from high-energy soft secondaries produced in the shielding matter by mesotron-electron collisions and by

mesotron bremsstrahlung, the frequency of burst production is calc. as a function of burst size. To obtain agreement with observed data a mesotron spin of 0 rather than $\frac{1}{2}$ or 1 is indicated. N. M. B.

Spin of the mesotron. J. R. Oppenheimer (*Physical Rev.*, 1941, [ii], 59, 462).—A crit. discussion of the work of Christy and Kusaka (cf. preceding abstracts). N. M. B.

Scattering of charged mesons. H. J. Bhabha and B. S. M. Rao (*Proc. Indian Acad. Sci.*, 1941, A, 13, 9—24).—The scattering of neutral mesons by the spin of the heavy particles on the quantum theory agrees with the scattering on the classical theory except for being larger by a const. factor 3 which is due to differences in the averaging over the initial directions of spin of the heavy particle. The scattering of charged mesons corresponds with the classical theory if certain assumptions (discussed) are made. W. R. A.

Reflexion and refraction of photons. E. T. Jones (*Phil. Mag.*, 1941, [vii], 31, 394—404).—The theory of the reflexion and refraction of vibratory doublet photons at the surface of a transparent isotropic medium is considered.

A. J. M.
Neutron-proton interaction. W. Rarita and J. Schwinger (*Physical Rev.*, 1941, [ii], 59, 436—452).—Mathematical. Field theories of nuclear forces predict a spin-dependent interaction similar in character to the coupling energy between two dipoles. The influence of such spin-spin forces on the behaviour of the neutron-proton system is studied, and a phenomenological theory is developed. The effects investigated include the magnetic moment of the deuteron, the scattering of neutrons in H_2 , the radiative capture of slow neutrons, and the photo-disintegration of the deuteron. Except for the last-named, which appears to require a detailed knowledge of the charge-bearing field, the theory adequately represents the experimental data. N. M. B.

Magnitude of electronic charges. A. Landé (*Physical Rev.*, 1941, [ii], 59, 434—435).—Mathematical. Quantum theory requires the product $\epsilon_0 t_0$ (classical rest energy \times characteristic wave period) for a charged point particle to be $\sim h/210$; the classical vals. of ϵ_0 and t_0 with their quantum product yield $\alpha = \sim 1/140$ for the Sommerfeld fine-structure const. instead of the experimental val. $1/137$. The discrepancy may be due to classical treatment of the interaction between light and charged matter. N. M. B.

Motion of gases in the sun's atmosphere. I. Mechanism of the formation of solar dark markings. A. K. Das (*Indian J. Physics*, 1940, 14, 369—386).—Mathematical. The dynamics of a mass of gas ejected from the photosphere or from levels below the photosphere has been studied. The theory explains quantitatively many features of solar dark markings. J. W. S.

Energy and wave-length maxima in Fermi-Dirac and Bose-Einstein distributions. A. G. Chowdhuri and B. N. Singh (*Indian J. Physics*, 1940, 14, 387—391).—Mathematical. The energy vals. corresponding with the max. in the energy-distribution curve and the vals. of the de Broglie wave-length corresponding with the max. in the λ -distribution curve are deduced for degenerate and non-degenerate cases. J. W. S.

Effect of an electric field of strength $-1/2\alpha F^2$ on the polarisability constant of the normal hydrogen atom. W. H. Robinson (*Indian J. Physics*, 1940, 14, 405—408).—From Eckart's val. of the integral for the upper limit of the energy in the lowest state of a system (A., 1930, 1491) and assuming the radius of the orbit in the normal H atom to be 0.5282×10^{-8} cm., the polarisability const. is calc. to be -0.58945×10^{-24} c.c., a val. in accord with that calc. from first- and second-order perturbation theory. J. W. S.

Bose-Einstein condensation. L. Goldstein (*J. Chem. Physics*, 1941, 9, 273—279; cf. A., 1940, I, 149).—Mathematical. The peculiar condensation in phase space of ideal Bose-Einstein gases is discussed when the internal energy states of the atoms or mols. is taken into account and when the gas of atoms without internal structure is placed in an external conservative field of force. The inclusion of the internal energy states decreases and the external field increases the condensation temp. Transition otherwise proceeds as for free gas atoms without internal structure. N. M. B.

II.—MOLECULAR STRUCTURE.

Excitation of hydrogen molecule by electron impact. R. Roscoe (*Phil. Mag.*, 1941, [vii], 31, 349—362).—The Born approximation is applied to calculations on the inelastic scattering in H_2 covering excitation of all the more important states by fast electrons. The differential cross-section for the aggregate of inelastically scattered electrons, and the cross-sections corresponding with the excitation of individual states, decrease continuously with increasing voltage and angle, there being no appreciable diffraction max. or min. The scattering curves for the B and C states are very similar. A finite cross-section is obtained for the 1X state, even at high voltages, showing that the optically forbidden $A \rightarrow ^1X$ transition can occur under electron excitation. The scattering curves for H_2 resemble closely the corresponding ones for He. The Frank-Condon principle does not give correct vals. for the relative probabilities of excitation of the vibrational levels. A. J. M.

Rotational analysis, perturbation, and predissociation in the CD and CH bands. L. Gerö and R. F. Schmid (*Physical Rev.*, 1941, [ii], 59, 528—529; cf. A., 1940, I, 144).—In strongly condensed high-frequency discharges through vapours of deuterio-paraffin and ordinary benzole under various pressures, the entire CD and CH spectra were photographed at high dispersion and resolution with a grating spectrograph. Rotational analysis of the 3150 Å. band of CD and a comparison of predissociation effects on the 4300 Å. bands of CD and CH are discussed (cf. *ibid.*, 281). N. M. B.

Nature of some spectra. D. S. Pavlov (*Acta Physicochim. U.R.S.S.*, 1940, 13, 587—590).—The band spectrum observed by Fowler and Vaidya (A., 1931, 996), and regarded by them as an emission spectrum of COS, is identical with the absorption spectrum of SO (cf. A., 1933, 475; 1937, I, 271) against a continuous background. The "ethylene bands" observed by Vaidya (A., 1935, 279) in the inner cone of the C_2H_4 flame are not identical with the bands (now known to be due to CH_2O) discovered by Emeleus (A., 1927, 7) in the cold flame of Et_2O . They are identical with bands observed by Beck and by Erichsen (B., 1936, 818) in the flames of liquid fuels, but the view of these authors that the state of aggregation of the fuel is significant in the origin of the bands is incorrect, for they are present in the spectrum of the flame of preheated petrol vapour. F. J. G.

Normal vibrations of molecules with internal torsional motions. B. L. Crawford, jun., and E. B. Wilson, jun. (*J. Chem. Physics*, 1941, 9, 323—329).—The vibrations of mols. comprising a framework to which are attached a no. of symmetrical groups are discussed theoretically. The vibrational selection rules are shown to be similar to those for normal mols. The results are applied particularly to $MeNO_2$, C_2H_6 , and CMe_4 . J. W. S.

Ionic association and absorption spectra. II. H. von Halban and M. Litmanowitsch (*Helv. Chim. Acta*, 1941, 24, 38—44).—Additional experiments on the influence of salts on the absorption spectra of dil. solutions of picrates confirm earlier observations (cf. A., 1937, I, 393) that the sp. influence of added cation on the spectra is practically independent of the anion. For the same anion there is considerable difference between the influence of various cations, especially at low λ . The influence of HCl on the absorption of picric acid (I) solutions has also been investigated. At $[HCl] > 7.2N$, the spectrum of (I) is practically identical with that of (I) in dioxan, indicating that in such solutions (I) is undissociated. C. R. H.

Long wave-length spectra of aldehydes and ketones. I. Saturated aldehydes and ketones. II. Conjugated aldehydes and ketones. H. L. McMurry (*J. Chem. Physics*, 1941, 9, 231—240, 241—251).—I. Intensity calculations indicate that of two theoretically predicted transitions, the forbidden transition should be identified with the weak longest- λ absorption characteristic of the unconjugated C=O group, since the calc. intensity of the other (allowed) transition greatly exceeds the observed intensity. The absorption regions at shorter λ in ketones and aldehydes are discussed. It is concluded that the λ 1900 region in ketones is characteristic of the C=O group and is due most probably to the above allowed transition or to a Rydberg transition. If the former is true the upper level of the λ 1900 absorption could

be largely responsible for the perturbations which cause the appearance of the long- λ forbidden transition. The long- λ absorptions from the C=S group are explained as in the case of those for C=O.

II. An interpretation of the long- λ absorption regions is given. The strong regions are assigned to transitions of the $N \rightarrow V_1$ type known to produce the intense long- λ absorption in polyenes. The weak regions, characteristic of C=O, are explained on the type of transition previously proposed to explain the weak C=O absorption in saturated aldehydes and ketones; such a transition involves the excitation of a loosely bound electron occupying a non-bonding orbital in the mol. plane and across the C—O direction, to an excited mol. orbital with a node in this plane. The longest- λ C=O absorption represents a transition to the lowest of these mol. orbitals; the observed shift to longer λ with each addition to the no. of conjugated bonds in the chain is explained by the reduction in energy of this lowest mol. orbital as the chain length increases. The longest- λ absorption for quinones and for aromatic aldehydes and ketones can be explained by the same process as that producing this absorption in chain mols. The long- λ spectra of mols. containing conjugated C=S groups are similar to those for analogous mols. containing C=O, and absorption from C=S is observed at longer λ because the orbital from which excitation comes is less firmly bound than in C=O. N. M. B.

[Relation between] structure and absorption spectra of $\alpha\beta$ -unsaturated ketones.—See A., 1941, II, 197.

Absorption spectra in relation to quinones: 1-4-naphthaquinone, anthraquinone, and their derivatives. R. A. Morton and W. T. Earlam (*J.C.S.*, 1941, 159—169).—Absorption spectra of 1:4-naphthaquinone and its alkyl and OH-derivatives are recorded and are accounted for by the summation of effects due to (a) $\cdot C_6H_4 \cdot CO \cdot R$ and (b) the quinonoid and CO chromophores; those of α -OH-derivatives are complicated by H-bonding. That of anthraquinone is closely reproduced by $2a + b$. In hydroxyanthraquinones the two bands ascribed to a can vary independently, as can those of b . α -Substitution tends to diminish the quinonoid element in b , and to enhance the CO aspect. β -Substitution has the reverse effect. A. Li.

Spectroscopic studies of the simpler porphyrins. II. Absorption spectra of porphin and isoporphin, *ms*-tetravanillin- and -tetravanilliniso-, -tetrapropyl- and -tetrapropyliso-, -tetra-*n*- and -tetraiso-butyl-porphin. H. V. Knorr and V. M. Albers (*J. Chem. Physics*, 1941, 9, 197—203; cf. A., 1936, 1048).—Absorption curves and mol. absorption coeff. data for a portion of the visible region are reported and variations in the coeffs. and spectral displacements, due to substitutions, are examined. N. M. B.

Configuration of the nickel salt of formylcamphor. H. S. French and (Miss) G. Corbett (*J. Amer. Chem. Soc.*, 1940, 62, 3219—3222).—The ultra-violet absorption spectrum in MeOH and the rotatory dispersion of Ni formylcamphor indicate that it is tetrahedral and not square coplanar. This is supported by the fact that it is paramagnetic. W. R. A.

Spectrophotometric study of the characteristics of halogen-substituted sulphonephthalein indicators. M. M. Haring and H. A. Heller (*J. Amer. Chem. Soc.*, 1941, 63, 1024—1027).—The indicator constns., effective ranges, and absorption max. of seven sulphonephthaleins with four halogen atoms in the sulphobenzoic acid nucleus have been determined. W. R. A.

Ultra-violet absorption spectrum of 1:3-cyclopentadiene. (Miss) L. W. Pickett, (Miss) E. Paddock, and (Miss) E. Sackter (*J. Amer. Chem. Soc.*, 1941, 63, 1073—1077).—Between ν 32,000 and 66,000 cm^{-1} the ultra-violet absorption spectrum of $\Delta^{1:3}$ -cyclopentadiene (I) consists of an intense broad band, max. 43,000 cm^{-1} , with narrow diffuse bands superimposed and a group of sharply defined narrow bands between 50,300 and 53,800 cm^{-1} . The vibrational structure of the discrete bands has been analysed. Two band systems are revealed with four prominent vibrational ν comparable with the totally symmetrical ν of the mol. in the ground state. The oscillator strength of the broad band is discussed. The spectrum of (I) in C_6H_{14} is similar to that of the vapour but the max. of the band is 1000 cm^{-1} nearer the visible and the no. of narrow superimposed bands is much smaller.

The spectrum of dicyclopentadiene in C_6H_{14} has also been measured. W. R. A.

Absorption spectra of ions of europium and the electric fields within some co-ordination compounds. S. Freed, S. I. Weissman, and F. E. Fortess (*J. Amer. Chem. Soc.*, 1941, **63**, 1079—1085).—Ions of Eu may be employed as spectroscopic indicators for the symmetry and for the intensity of the electric fields of their environment in solution as well as in crystals. Eu acetylacetonate forms dimerides in solution and the processes of formation and dissociation have been followed spectroscopically. Dimerides and monomerides exist in two stereoisomeric forms. The chelate co-ordinate compounds of Eu with acetyl-, methylacetyl-, and benzoyl-acetone, and salicylaldehyde have been examined and the symmetries of the fields about the central ion have been derived. The symmetries about the ions in solution differ from those in the crystals. W. R. A.

Spectroscopic evidence for hydrogen bonds: comparison of proton-attracting properties of liquids. III. W. Gordy and S. C. Stanford. IV. W. Gordy (*J. Chem. Physics*, 1941, **9**, 204—214, 215—223; cf. A., 1940, I, 193).—III. Data for the absorption of the OD group of MeOD in 77 org. solvents, with positions of the band and shifts from the position of the unperturbed OD absorption band, are tabulated and variations due to structure are reported. With certain exceptions a linear relation exists between the log of the basicity const. of the solvents as measured in aq. solution and the shifts they cause in the OD band. There is a close correlation between the effects of these solvents on the OD band of MeOD and their solubilities and heats of mixing with certain other compounds, but not between the absorption data and dipole moments and ϵ of the solvents. A relation exists between the proton-acceptor power of a given atom and the electro-negativities of the atoms adjacent to it in the mol.

IV. The strengths of D bridges formed between D_2O and 42 basic solvents are compared by measurements of perturbations produced by the solvents on the OD vibrational band at 3.59μ . in D_2O vapour and at 4.00μ . in D_2O liquid. For comparison of proton-attracting properties of 25 solvents, measurement of the strengths of H bonds which they form by sharing the proton of HCl was satisfactory for very weak bases and that of D_2O for strong and moderately weak bases. The shifts produced by the liquids on the D_2O and HCl bands are linearly related (with small variations) with the shifts produced on the OD band of MeOD. The shifts produced by 19 solvents on the D_2O band are \propto the log of their basicity const. N. M. B.

Spectroscopic evidence for intermolecular hydrogen bonds between phenylacetylene and various organic solvents. S. C. Stanford and W. Gordy (*J. Amer. Chem. Soc.*, 1941, **63**, 1094—1096).—Mixtures of C_6H_5CH with org. solvents (1:1) have been investigated in the $3\text{-}\mu$. region. With CCl_4 and $PhCl$ no shifts occur. With $COMe_2$, dioxan, and Et_3PO_4 absorption max. shift to longer λ and the band is intensified. Similar shifts to longer λ were encountered with $HCO \cdot NMe_2$, NMe_2Ac , C_5H_5N , piperidine, quinoline, and cyclohexyldimethylamine. The H of the CH group forms weak H bonds with the O and N compounds, but those with N compounds are slightly stronger than those with O compounds, thereby causing a greater shift in λ . Observed shifts are approx. in the same order as the shifts in the location of the OD band of MeOD in the same solvents. W. R. A.

Ultra-violet absorption of the diphenic acids. E. C. Dunlop, (Miss) B. Williamson, W. H. Rodebush, and A. M. Buswell (*J. Amer. Chem. Soc.*, 1941, **63**, 1167).—The absorption spectrum of *oo'*-diphenic acid (I) is practically identical with that of $BzOH$, and evidently the CO_2H groups interfere to such an extent that the coplanar position is impossible and resonance between the rings disappears. In the *pp'*-acid (II) there is exact coplanarity and complete resonance and large absorption with max. at 2800 \AA . The absorption of the *mm'*-acid is \gg that of (I) and \ll that of (II) and the max. is shifted to shorter λ . Complete details and discussion will be published later. W. R. A.

Mitogenetic emission spectra of radicals. A. Gurvitsch and L. Gurvitsch (*Acta Physicochim. U.R.S.S.*, 1940, **13**, 677—682).—OH radicals produced photochemically from H_2O_2 can be excited by mitogenetic radiation in systems

containing yeast or $CO(NH_2)_2$ + urease, giving an emission band at λ 3050—3100 \AA ., corresponding with the strongest obtainable by thermal treatment. An emission band at 2020—2040 \AA ., obtained from $COMe_2$ in similar systems, is attributed to the $\cdot CO \cdot$ radical. F. L. U.

Quenching and inhibition of mitogenetic radiation. A. Gurvitsch and L. Gurvitsch (*Acta Physicochim. U.R.S.S.*, 1940, **13**, 683—689).—All sol. substances which absorb in the ultra-violet can act as quenchers of every kind of mitogenetic radiation. They include not only As, I, quinine, etc., but also substances of undetermined nature that are produced by the external radiation; these latter are responsible for the rapid "fatigue" exhibited by yeast cultures, as shown by the fact that a fresh yeast culture to which a small proportion of a "fatigued" culture has been added is thereby rendered useless. Inhibitors differ from quenchers in affecting only the radiation induced by exothermic chemical reactions, including decomp. by enzymes. They are used up in the process of inhibition, and in no way disturb the course of the accompanying fermentative change. The no. of mols. of inhibitor taking an active part in inhibition is very small compared with that of the enzyme or substrate mols. taking part in the enzyme reaction. F. L. U.

Electronic Raman effect. E. Gross, A. Raskin, and A. Seidel (*Acta Physicochim. U.R.S.S.*, 1940, **13**, 591—594).—The claim of Sibaiya and Venkataramiah (A., 1939, I, 550) to have observed a Raman shift due to an electronic transition in aq. $Sm(NO_3)_3$ is erroneous. Their results are due to superposition of the absorption bands of Sm^{III} on the continuum near the exciting line λ 4358 in the Hg arc. F. J. G.

Raman spectrum of gypsum. B. D. Saksena (*Proc. Indian Acad. Sci.*, 1941, **A**, 13, 25—32).—The spectra of a single crystal of gypsum in different orientations with polarised and unpolarised incident light have been investigated and the state of polarisation of some of the lines has been determined. The data comply with the requirements and selection rules for a monoclinic crystal. The frequencies 415, 492, and 1006 cm^{-1} are totally symmetrical, and 618, 672, and 1136 cm^{-1} are antisymmetrical, vibrations. W. R. A.

Relative intensities of Stokes and anti-Stokes Raman lines in crystals. K. Venkateswarlu (*Proc. Indian Acad. Sci.*, 1941, **A**, 13, 64—67).—The ratio of the intensities of the Stokes and anti-Stokes lines of quartz and calcite has been measured. Vals. calc. by the formula of Ornstein and Rekveld (A., 1929, 1362) are in better agreement with observed vals. than those calc. by the formula of Raman and Krishnan (A., 1929, 240). W. R. A.

Association of acetic acid in non-aqueous solvents. P. Koteswaram (*Indian J. Physics*, 1940, **14**, 333—339).—The Raman frequencies of $AcOH$ in $CHCl_3$ are the same as those for the pure acid, but in $PhNO_2$, Et_2O , and $COMeEt$, as in $COMe_2$ (A., 1939, I, 261), distinct shifts are observed, particularly in the 1670 cm^{-1} $C=O$ frequency, together with new frequencies. These are attributed to the formation of H bonds between the OH of the $AcOH$ and the O atoms of the solvents and to the unco-ordinated $C=O$ in the disrupted acid complexes, respectively. J. W. S.

Molecular association in acetone and methyl ethyl ketone. P. Koteswaram (*Indian J. Physics*, 1940, **14**, 341—351).—The 1712 cm^{-1} $C=O$ frequency of $COMe_2$ is shifted towards lower ν by dilution with H_2O , $MeOH$, $PhOH$, or $AcOH$, whilst the 788 cm^{-1} $C-H$ frequency is shifted towards higher ν . In $AcOH$ a new 1760 cm^{-1} frequency is produced. C_6H_6 , CCl_4 , Et_2O , and $CHCl_3$ have no effect on the Raman spectrum. The results are explained on the basis of association of $COMe_2$ mols. with mols. capable of forming H bonds with its $C=O$ group. Similar results are obtained with $COMeEt$. J. W. S.

Molecular association as studied by the Raman effect. P. Koteswaram (*Indian J. Physics*, 1940, **14**, 353—357).—Raman effect investigations indicate that in pure liquids, whether polar or not, association can occur only when the mols. contain both donor and acceptor atoms, thus permitting the formation of co-ordinate linkings between one mol. and another. Mols. having only a donor or acceptor atom cannot associate with others of the same type, but can form complexes with mols. containing an acceptor or donor atom, respectively. Mols. with no acceptor or donor atom, whether

polar or not, cannot associate with other mols. with such atoms. Unassociated polar liquids cause a splitting of the associated mols. of other liquids, whilst two associated liquids appear to have a mutual splitting effect. J. W. S.

Frequency changes in the Raman spectrum of sulphuric acid. N. R. Rao (*Indian J. Physics*, 1940, 14, 359—364).—On dilution with H_2O the max. of the 415 and 570 cm^{-1} Raman bands of H_2SO_4 are shifted towards higher ν , whilst the max. of the 913 cm^{-1} band is shifted towards lower ν . This behaviour is attributed to changes in the proportions of H_2SO_4 , HSO_4^- , and SO_4^{2-} , which contribute components to these bands. Dilution initially causes a decrease in the ν of the 1040 cm^{-1} band, but finally an increase is observed, this effect being attributed to the influence of the surrounding ions and of hydration, which tend to increase and diminish ν , respectively. The 984 cm^{-1} frequency is unaffected by dilution. The lowering of the 913, 984, and 1040 cm^{-1} frequencies in $KHSO_4$ as compared with H_2SO_4 is attributed to the predominance of hydration over ionic atm. effects. J. W. S.

Effect of temperature on the Raman spectrum of glycerol. A. L. S. Rao (*Indian J. Physics*, 1940, 14, 365—367).—The Raman spectrum of 75% and 25% aq. glycerol (I) has been investigated at 30° and 100°, 16 lines being detected and some of them assigned to C—C, C—O, C—H, and $\delta(C-H)$ vibrations. Dilution or rise of temp. causes a weakening of the 604 and 820 cm^{-1} lines, whilst the 674 cm^{-1} line becomes weaker and more diffuse and increases in frequency. These effects are attributed to depolymerisation of (I) complexes. J. W. S.

Infra-red and Raman spectra of polyatomic molecules. XIII. Nitromethane. A. J. Wells and E. B. Wilson, jun. XIV. Propylene. E. B. Wilson, jun., and A. J. Wells (*J. Chem. Physics*, 1941, 9, 314—318, 319—322; cf. A., 1940, I, 345).—XIII. The infra-red absorption of gaseous $MeNO_2$ has been studied from 3 to 25 μ , and the Raman spectrum has been reinvestigated. The data, with a partial normal co-ordinate treatment, permit assignment of the observed lines and bands accounting for all fundamental frequencies except the torsion about the C—N linking. XIV. The infra-red spectrum of gaseous C_3H_6 has been studied from 3 to 25 μ , and a normal co-ordinate calculation of the fundamental frequencies has been made, using force consts. derived *a priori* from C_2H_4 and C_2H_2 . The results, combined with Raman data, permit assignment of 15 of the 20 fundamental frequencies and approx. evaluation of 4 of the remainder. J. W. S.

Raman spectrum of *n*-dodecyl bromide. F. F. Cleveland and M. J. Murray (*J. Chem. Physics*, 1940, 8, 867—868).—Raman displacements and their relative intensities and depolarisation factors for liquid $n-C_{12}H_{25}Br$ are recorded. The strong polarised 563 and 647 cm^{-1} frequencies are attributed to vibrations characteristic of the CH_2Br group involving chiefly the C—Br linking, whilst other frequencies in the range 1000—3000 cm^{-1} are closely similar to the infra-red-active chain and end frequencies observed with $C_{11}H_{24}$ (A., 1940, I, 194). J. W. S.

Raman effect of fluorodichloromethane. G. Glockler, W. F. Edgell, and G. R. Leader (*J. Chem. Physics*, 1940, 8, 897—898).—The Raman spectrum of CH_2Cl_2 has been reinvestigated. The 8 lines recorded by Bradley (A., 1932, 897) are confirmed and an extra fundamental is observed at 1254 cm^{-1} . The line previously reported at 723 cm^{-1} has been resolved into a doublet at 723 and 738 cm^{-1} , this being attributed to Fermi resonance between the first overtone of 366 cm^{-1} and a fundamental near 732 cm^{-1} . The results are in accord with the assignment of fundamentals recorded previously (A., 1940, I, 429). J. W. S.

Fundamental frequencies of certain halomethanes. II. Raman spectrum of fluoroform. G. Glockler and W. F. Edgell (*J. Chem. Physics*, 1941, 9, 224—231; cf. A., 1940, I, 429).—Raman data and assignment of the six fundamentals of CHF_3 are reported. The fundamentals in $CHCl_3$ are revised to harmonise with the data of CHF_3 and are empirically correlated in several spectral sequences. Molar heat capacities in the range 250—650° K. for CHF_3 , $CHCl_3$, and CH_2Cl_2 are calc. and compared with available data, and are fitted to empirical equations (shown accurate to 5%) corr. to finite pressures by the modified Berthelot equation of state. N. M. B.

Rotational isomerism in the alkyl halides. W. F. Edgell and G. Glockler (*J. Chem. Physics*, 1941, 9, 375—376).—The existence of two C—X frequencies in alkyl halides can be accounted for by the presence of *trans*- and *C₂* forms, the latter resulting when the CH_2X groups are rotated 120° from the *trans*-positions. This view is better in harmony with the observed depolarisation of Raman lines than is the assumption of the presence of *trans*- and *cis*-forms. J. W. S.

Vibrations of long-chain molecules; Raman spectra of *n*-octane, decane, cetane, and eicosane in the liquid state. E. J. Rosenbaum (*J. Chem. Physics*, 1941, 9, 295—297).—Raman spectral frequencies of liquid $n-C_8H_{18}$, $C_{10}H_{22}$, $C_{16}H_{34}$, and $C_{20}H_{42}$ are recorded. With increasing chain length the lines of $\nu < 800$ cm^{-1} become fewer and very diffuse. This is interpreted in terms of a no. of coexisting chain configurations in the liquid state, and it is considered that theories which assume that the C atoms in a chain are coplanar are inapplicable to liquid paraffins. J. W. S.

Photosensitisation and fluorescence by aromatic hydrocarbons. W. West and W. E. Miller (*J. Chem. Physics*, 1940, 8, 849—860).—The optical sensitising power of aromatic hydrocarbons and their derivatives towards the decomp. of alkyl iodides in C_6H_{14} is shown to be parallel to the ability of the acceptor to quench the fluorescence of the sensitiser. The quantum yield (Φ) of the decomp. of EtI sensitised by $C_{10}H_8$ follows the relation $1/\Phi = a + b/[EtI]$, where a and b are consts. The results are in accord with the view that excited $C_{10}H_8$ mols. disappear in competing processes of fluorescence, photosensitisation, and internal dissipation of electronic energy. A mechanism of the photosensitisation is suggested. J. W. S.

Thermal activation of the oxygen molecule. H. D. Hagstrum and J. T. Tate (*Physical Rev.*, 1941, [ii], 59, 509—513; cf. A., 1941, I, 193).—Using a mass spectrometer as a partial pressure gauge, changes in relative partial pressures of O_2 and impurities (CO_2 , CO, and H_2O) with temp. of a Pt filament operated in O_2 in the vac. system were studied at $\sim 10^{-4}$ mm. Hg pressure. The partial pressure of O_2 began to fall at $\sim 1280^\circ$ K. filament temp., reaching 46% of its original val. at 1740° K. The fall in O_2 abundance was accompanied by rises in those of CO_2 , CO, and H_2O , and finally the effect disappeared. Evidence indicates that the process responsible for the effect involves the adsorption on the hot Pt of O_2 mols. which on evaporation in activated form react with substances of low v.p. adhering to the glass. The nature of the activation is probably excitation to the metastable mol. states $^1\Delta$ and $^1\Sigma$. Results on the dissociation of H_2 by a hot W filament agreed with former data. N. M. B.

Dielectric constants of aliphatic ketones. R. H. Cole (*J. Chem. Physics*, 1941, 9, 251—257).—Data for ϵ and density reported for 8 aliphatic ketones over the liquid-phase temp. range indicate that dipole-dipole coupling is the important factor in determining ϵ of these liquids, and show departures, not attributable to proton bonding, from Onsager's theory. Use of the Onsager formula to calculate dipole moments from ϵ data on the pure polar liquids is not justified in the case of the ketones. Results are consistent with Kirkwood's theory (cf. A., 1940, I, 10), and ϵ of *n*-aliphatic alcohols are consistent with that theory as applied to a crude model of the liquid "structure" of these alcohols. N. M. B.

Dispersion and absorption in dielectrics. I. Alternating current characteristics. K. S. Cole and R. H. Cole (*J. Chem. Physics*, 1941, 9, 341—351).—The dispersion and absorption of many liquid and solid dielectrics can be represented by the empirical formula $\epsilon^* - \epsilon_\infty = (\epsilon_0 - \epsilon_\infty)/[1 + (i\omega\tau)^{1-\alpha}]$, where ϵ^* , ϵ_0 , and ϵ_∞ are the complex, static, and infinite frequency dielectric consts., respectively, and τ is a generalised relaxation time. α can assume any val. from 0 to 1; when $\alpha = 0$ the expression reduces to the Debye equation for polar dielectrics. The behaviour of the dielectric can be represented by an equiv. electrical circuit containing a complex impedance, the phase angle of which is independent of frequency. Energy is "stored" as well as dissipated, and the ratio of the average energy stored to the energy dissipated per cycle is independent of frequency. J. W. S.

Measurement of the dielectric constants of vapours and the polarisations of trimethylaluminium, dimethylaluminium chloride, and methylaluminium dichloride. R. H. Wiswall, jun., and C. P. Smyth (*J. Chem. Physics*, 1941, 9, 352—356).—A

modified apparatus for measuring ϵ of gases and the method for its calibration are described. The ϵ of AlMe_3 and AlMe_2Cl vapours have been measured at various temp. and pressures, and the ϵ of solutions of AlMeCl_2 in C_6H_6 have been measured at 25°. The results lead to apparent dipole moments, in D., of 1.34—1.46, 1.61—1.73, and 1.96, respectively, but strong mol. association prevents accurate calculation of the true vals. Review of the data indicates that AlMe_3 is probably pyramidal, the larger size of the Al atom rendering this structure more stable than in BMe_3 . It also supports the view that the Al—C linking is predominantly covalent. J. W. S.

Dielectric loss in thin films of insulating liquids. C. G. Garton (*J. Inst. Elect. Eng.*, 1941, 88, Part II, 103—120).—The variation with stress of the dielectric loss in very thin films of insulating liquids, such as might be found in porous, impregnated insulation, is considered. In this case the motion of ions under an alternating field is limited by the film boundaries. If the thickness of the film is known, the variation of the loss angle may be used to calculate the no., mobility, and radius of the ions. Experiments with films of $\text{C}_6\text{H}_5\text{Cl}_3$ (I), 0.3 mm. thick, show that they undergo considerable variations of loss angle with stress, the results agreeing with the theoretical deductions, except at very low stresses. The angle of loss is affected considerably by impurities. (I) purified by vac. distillation has a loss angle as low as 0.001 instead of the usually accepted val. 0.04. It is suggested that if some method could be devised for reducing ionic motion, such as very small pore size, it would be possible to use liquids of higher ϵ than is now practicable for condenser impregnation. A. J. M.

Measurement of dielectric loss. I. Lohdes apparatus for measuring dielectric loss factor. II. Experimental result of measuring dielectric loss factor of polar-nonpolar solution. III. Quartz condenser for measuring small dielectric loss factor. IV. Experimental result of measuring dielectric loss factor of cyclohexanol in benzene, in cyclohexane, and in decalin. V. Calculation of "time of relaxation," "molecular radius," and molecular polarisation. S. Takashima (*J. Soc. Chem. Ind. Japan*, 1940, 43, 373—374B).—See A., 1938, I, 345, 436. D. F. R.

Ionic character and dipole moments of bonds. M. E. Diatkina (*Acta Physicochim. U.R.S.S.*, 1940, 13, 639—646).—On the basis of Wall's theory (A., 1940, I, 244) dipole moments of the "transition" structures are calc. for a no. of compounds, and a physical interpretation of these structures is offered. Calculation of the wts. of the various structures for the NH_3 mol. shows that the Kossel structure ($\text{N}^3-\text{H}^+\text{H}^+\text{H}^+$) is insignificant, whilst the transition structures are of great importance. The dipole moment of homopolar structures is very small and may be ignored. F. L. U.

Induction and dipole moment in chloro- and nitro-paraffins. R. H. Wiswall, jun., and C. P. Smyth (*J. Chem. Physics*, 1941, 9, 356—361).—From measurements of the dielectric consts. of the vapours at various temp. and pressures, combined with n_D^{20} data, the following dipole moments, in D., are derived: Bu^nCl 2.04, sec.-BuCl 2.12, Bu^iCl 2.13, CMeCl_3 1.77, Pr^nNO_2 3.72, Pr^iNO_2 3.73, Bu^iNO_2 3.71. The greater increase on passage from Bu^nCl to sec.-BuCl and Bu^iCl in the vals. calc. from measurements on solutions is attributed to solvent effect. The differences in moment observed in the homologous series are of the order anticipated from inductive effects. J. W. S.

Solvent effect of dipole moments of disubstituted benzenes. K. Higasi (*Bull. Inst. Phys. Chem. Res., Japan*, 1941, 20, 218—224).—The following vals. are given, solvent in parentheses: $o\text{-C}_6\text{H}_4\text{Cl}_2$ 2.00 (Et_2O); $m\text{-C}_6\text{H}_4\text{Cl}_2$ 1.33 (Et_2O); $m\text{-C}_6\text{H}_4(\text{NO}_2)_2$ 4.07 (C_6H_{14}), 3.96 (C_6H_6), 3.32 (Et_2O). W. R. A.

Densities and refractive indices of unsaturated hydrocarbons. M. L. Huggins (*J. Amer. Chem. Soc.*, 1941, 63, 916—920).—The simple additivity relations used previously (A., 1941, I, 99) must be replaced by slightly more complicated equations in order to obtain agreement between observed and calc. mol. vol. and mol. refraction. W. R. A.

Novel application of co-ordination compounds. D. P. Mellor (*J. Proc. Austral. Chem. Inst.*, 1941, 8, 38—41).—The I_3^- ion appears to be unique in its capacity of giving dichroic cryst. compounds with marked anisotropy of absorption in

the visible region. Complex I_3^- compounds containing large complexes such as $[\text{CoCl}(\text{NH}_3)_5]$, quinine, and some other alkaloids give crystals capable of orientation to form polarising screens. L. J. J.

Polarisation of ions and lattice distances. K. Fajans (*J. Chem. Physics*, 1941, 9, 281—282).—A consideration of the causes of deviations from additivity shown by the molar refraction of inorg. compounds. The influence of the polarisation of the ions on lattice distance is shown. N. M. B.

Molar volume, refraction, and interionic forces. K. Fajans (*J. Chem. Physics*, 1941, 9, 282; cf. preceding abstract, also A., 1941, I, 264).—Theory indicates that the addition of a cation to an anion leads to a diminution of the refraction (polarisability) of the anion and a contraction of its vol., with an expected increase in the size of the cation. These expectations are confirmed for the alkali halides by plotting differences between the molar vols. of the solids and the apparent vols. of the salts in infinitely dil. solution. N. M. B.

One-sided polarisation of ions in vapour molecules. K. Fajans (*J. Chem. Physics*, 1941, 9, 378—379; cf. two preceding abstracts).—Measurements of interat. distances in vapourised mols. of alkali and TI^+ halides (A., 1936, 670; 1938, I, 17) indicate that the one-sided action occurring in the vapour state causes contraction particularly of the TI —halogen distances. This confirms the view that the structure of TI^+ halides is nearer to covalent than ionic and explains the facts that TiCl is less dissociated in aq. solution than are the alkali halides and has a relatively low b.p. (806°). The existence of three different interionic distances in rhombic TlF and TlI is discussed. It is assumed that the largest distance is due to a loosening effect by the anions interpenetrating the TI^+ ion, whilst the smallest distance is due to tightening of anions by the TI^+ ion. J. W. S.

Local field in polarised dielectrics. G. Jaffé (*J. Chem. Physics*, 1940, 8, 879—888).—A new derivation of the Lorentz formula is given. Application of a similar treatment to the Onsager theory leads to an extension of this theory to cover media of variable density, which indicates that even for non-polar substances the Clausius-Mosotti expression is a complex function of density. The Markhoff-Gans theory is used to derive the distribution law of the local field for dipoles of const. moment, and it is shown that the mean val. of the resultant local forces is $>$ twice the max. val. of the Lorentz force. Calc. deviations from the Clausius-Mosotti and Lorentz-Lorenz expressions are compared with experimental data for CO_2 , PhCN , MeBr , MeI , EtBr , EtI , and PhCl . J. W. S.

Some applications of the kinetic theory to the behaviour of long-chain compounds. H. Mark (*J. Appl. Physics*, 1941, 12, 41—44).—The cooling energy and cooling entropy developed when long-chain mols. pass from the extended to the contracted state are discussed relative to the m.p., swelling, and η (of solutions) of the long-chain compounds. D. F. T.

Recombination of iodine and bromine atoms. O. K. Rice (*J. Chem. Physics*, 1941, 9, 258—262).—Data on the rate of recombination of I and Br atoms in the presence of an inert gas (cf. Rabinovitch, A., 1936, 788, 1348) are used, with equilibrium data, to calculate the rate of dissociation of I_2 and Br_2 , and results are used to obtain effective collision radii for I_2 and Br_2 mols. with inert gas mols. For monat. or simple inert gas mols. the effective radii are approx. those of kinetic theory, when allowance is made for the density of energy levels in excited I_2 and Br_2 . The interpretation of anomalously large radii is discussed. N. M. B.

Anharmonicity of vibrations of polyatomic molecules. I. O. Redlich (*J. Chem. Physics*, 1941, 9, 298—306).—Simplifying assumptions concerning the vibrational potential energy of polyat. mols. are discussed with reference to relevant experimental data. Relations between the higher coeffs. of the potential energy of mols. containing several equiv. bonds are derived. With p equiv. bonds the potential energy of the corresponding symmetric stretching vibration is given approx. by a Morse function with consts. pD and a/\sqrt{p} instead of D and a . J. W. S.

Chemistry and structure. II. A. A. Balandin (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 571—584; cf. A., 1936, 167).—Theoretical. Structural matrices expressing space

configuration, composition, structure, internal mobility, and orientation of mols. are proposed. Many other properties, such as mol. n , mol. vol., dipole moment, cryst. structure, etc., can be expressed by developments of the matrix system. R. T.

Possible new approach to the study of the hydrogen linking in protein structure. A. E. Alexander and E. K. Rideal (*Nature*, 1941, 147, 541).—Recent measurements on simple compounds containing the $\text{CO}\cdot\text{NH}$ linking indicate that cross-H linking between such groups occurs in H_2O provided that the mol. spacing is suitable. The monolayer behaviour of amides, carbamides, aldolximes, and $\alpha\text{-NH}_2$ -acids can be interpreted by assuming cross-H linking between the mols. in the monolayer. L. S. T.

Organic linking strengths and the heat of vaporisation of carbon. E. C. Baughan (*Nature*, 1941, 147, 542).—A discussion. The assumption that the heat of vaporisation of graphite to monat. C vapour is ~ 168.8 kg.-cal. reconciles the serious discrepancies between kinetic and thermochemical vals. for C linking strengths. L. S. T.

Entropy of surface formation. W. H. Rodebush (*J. Chem. Physics*, 1941, 9, 284).—Mathematical. On the basis of a crude model of a monat. liquid, an approx. calculation of the increase in entropy on surface formation is made. N. M. B.

Reflexion and diffraction of molecular beams at lithium fluoride cleavage surfaces. W. H. Bessey (*Physical Rev.*, 1941, [ii], 59, 459).—Anomalies reported by Frisch (cf. A., 1933, 994) were investigated by reflecting He atoms or H_2 mols. from freshly cleaved LiF at 18° glancing angle. Results show no evidence of diffraction effects. The reflectivity curves obtained are explained by postulating that the crystals are not ideal but are made up of many crystallites up to 1 mm. diameter, tipped at small angles to each other. N. M. B.

III.—CRYSTAL STRUCTURE.

Crystals and photons. (Sir) C. V. Raman (*Proc. Indian Acad. Sci.*, 1941, A, 13, 1—8).—An address reviewing Indian contributions to the physics of crystals during 1940. W. R. A.

Diffuse reflexion of X-rays. G. D. Preston (*Nature*, 1941, 147, 467—471).—A review. L. S. T.

X-Ray diffraction maxima at other than Bragg angles. P. Kirkpatrick (*Physical Rev.*, 1941, [ii], 59, 452—455).—Observations show that the angle of deviation of Mo $K\alpha$ lines internally reflected from (111) planes of diamond is not const. with angle of incidence but varies in qual. agreement with Zachariasen's theory of diffuse scattering (cf. A., 1940, 1, 285). Variations of line intensity and width with angle of incidence do not agree well with the theory. Differences in the range of reflexions, from slightly ground and from untreated cleavage surfaces of calcite, of radiation incident at angles differing from the Bragg angle indicate that disordered crystal particles are the principal source of reflected intensity at other than Bragg angles in the case of the ground surfaces. Anomalous reflexions are probably due to this cause. N. M. B.

Modified reflexion of X-rays by crystals. G. E. M. Jauncey (*Physical Rev.*, 1941, [ii], 59, 456—458).—The existence, in X-ray crystal photographs, of diffuse spots which do not belong to the Laue pattern has been attributed to the breaking up of the crystal into small groups of atoms by thermal agitation (cf. Preston, A., 1939, I, 553). A formula derived by Bragg (cf. A., 1941, 1, 30) is examined for the shift in the position of the diffraction max. as the group of 8 atoms at the corners of a cube is turned away from the position for the Laue-Bragg diffraction max. Results show that the approx. formula for the shift is the same as that derived on different assumptions by Zachariasen (cf. A., 1940, I, 285). N. M. B.

Study of carbon by the Debye-Scherrer method. A. Taylor (*J. Sci. Instr.*, 1941, 18, 90—94).—The technique of taking Debye-Scherrer photographs of various modifications of C with standard cameras of the Bradley type is described; the advantages of using a 19-cm. diameter camera to show details, which are lost when a 9-cm. camera is used, are briefly described. The crystallite dimensions are calc. from curves obtained with a manually-operated null-deflexion G 2 (A., 1.)

microphotometer of the Dobson type, using a new definition of line broadening. Variations in crystallite dimensions of different carbons are given. D. F. R.

Crystal lattice deformation of rolled magnesium. D. E. Thomas (*Phil. Mag.*, 1941, [vii], 31, 425—431).—The crystal lattice orientation of rolled Mg, examined by transmitted and reflected X-rays, shows a departure from true fibre structure. There is a very strong orientation of the 002 planes in the plane of rolling. An interpretation is offered. A. J. M.

Interesting changes of physical conditions in a piece of tungsten. F. Brech (*J. Sci. Instr.*, 1941, 18, 101—102).—Variations of cooling stresses in a W target of an X-ray tube which fractured as a result of overloading have produced within 6 mm. areas in which (a) cooling from the recrystallisation temp. has fractured many grains into crystallites, (b) cooling from above recrystallisation temp. has fractured larger grains into smaller ones with large differences of orientation, and (c) a large grain has fractured into crystallites oriented about a cylindrical axis. Secondary fragmentation of some of the crystallites has also occurred. D. F. R.

Significance of large bond angle distortions in relation to the stereochemistry and magnetic properties of quadricovalent metals. D. P. Mellor (*J. Proc. Roy. Soc. N.S. Wales*, 1940, 74, 129—140).—The existence of large deformations of bond angles, as revealed by electron and X-ray diffraction investigations, is discussed. The possible configurations in which distorted tetrahedral bonds, and distorted square bonds, respectively, can occur, and the effect of the distortion on the nature of the compound, are considered. Baeyer's assumption that the angle between the valency bonds of C can be altered from the normal tetrahedral val., $109^\circ 27'$, can be extended to the valency bonds of many other atoms, not only those of the tetrahedral class but also those forming bonds normally at 90° . The val. of investigation of the magnetic properties of a compound in deciding the nature of bonds in distorted complexes is emphasised. A. J. M.

X-Ray examination of vanadium nitride. II. Precision determination of the unit cube edge of vanadium nitride. A. Brager and V. Epelbaum (*Acta Physicochim. U.R.S.S.*, 1940, 13, 600—603; cf. A., 1941, 1, 277).— a for VN is 4.129 \AA , the usually quoted val. being 4.28 \AA . The result is in close agreement with the val. 4.13 \AA recently found by Dawihl and Rix (*Z. anorg. Chem.*, 1940, 244, 191). $\rho_{\text{calc.}} = 6.04$ and $\rho_{\text{obs.}} = 5.62$. Comparison of a vals. for VC, VN, and VO indicates their relations to the radii of the second atom (C, N, O). F. J. G.

Dependence of the unit cube edge of TiC, TiN, and TiO on the radius of the metalloid atom. A. Brager (*Acta Physicochim. U.R.S.S.*, 1940, 13, 723—724; cf. A., 1940, I, 61).—The unit cube edge of TiC, TiN, and TiO decreases as the at. wt. of the second atom increases, as with the corresponding V compounds (cf. preceding abstract). F. L. U.

X-Ray studies on bismuth oxychloride, oxybromide, and oxyiodide. L. G. Sillén (*Svensk Kem. Tidskr.*, 1941, 53, 39—43).—Cell dimensions and at. parameters of the BiOX ($X = \text{Cl, Br, I}$) compounds have been determined. Powder photographs could be completely explained by the occurrence of tetragonal unit cells. The cell dimensions were not changed when the substances were heated to 500° , but above 600° all these compounds were converted into new ones giving distinct powder photographs, much richer in lines than those of BiOX . A. J. M.

Verification of the theoretical numbers of components into which electronic energy levels are decomposed by crystals. S. Freed and S. L. Weissman (*J. Chem. Physics*, 1940, 8, 878—879).—Pure EuF_3 crystals of symmetry C_{2v} and mixed crystals of EuF_3 with excess of BiF_3 of symmetry O_h show a splitting of the $J = 2$ levels into 5 and 2 components, respectively, and of the $J = 3$ levels into 7 and 3 components, respectively, as predicted theoretically (Bethé, A., 1929, 1367). J. W. S.

Crystal density of native cellulose. W. J. Lyons (*J. Chem. Physics*, 1941, 9, 377—378).—From Meyer's dimensions of the unit cell of native cellulose (A., 1937, I, 226) and the assumption that the mol. wt. of the cellobiose residue is 324.16, the density of cellulose is calc. to be 1.582, in accord with the mean val. of 1.585 for the density of α -cellulose in

standard cotton linters obtained by Stamm and Hansen (B., 1938, 44). J. W. S.

Unit cell measurements of Pb_2O_4 , Pb_2O_3 , and Ti_2SO_4 . S. T. Gross (*J. Amer. Chem. Soc.*, 1941, 63, 1168).— Pb_2O_4 crystals are tetragonal and not monoclinic as previously reported (A., 1938, I, 41). They have a_0 8.86, c_0 6.66 Å., ρ 9.1, 4 mols. per unit cell, extinctions, $h0l$ interferences present only when h is even, space-group $P4_2b$ (D_{2d}^{10}). Pb_2O_3 crystals are monoclinic and not triclinic as previously reported (A., 1938, I, 41); they have a_0 7.03, b_0 5.62, c_0 3.93 Å., β 82°, ρ 9.925, 2 mols. per unit cell, apparent extinctions $0k0$ present only when k is even, probable space-group $P2_1/m$ (C_{2h}^2) or $P2_1$ (C_2). Orthorhombic Ti_2SO_4 crystals are isomorphous with K_2SO_4 , a_0 10.68, b_0 6.02, c_0 7.81, ρ 6.77, extinctions, $h0l$ present only when h is even, $0kl$ present only when $(k+l)$ is even, 4 mols. per unit cell, space-group $Pnma$ (V_h^{10}). W. R. A.

Molecular structures of methyl isocyanate and cyanic acid by the electron diffraction method. Structural chemistry of cyanic acid and its derivatives. E. E. Eyster, R. H. Gillette, and L. O. Brockway (*J. Amer. Chem. Soc.*, 1940, 62, 3236—3243).—Electron diffraction photographs for gaseous MeNCO yield $\text{N}=\text{C}=1.19\pm0.03$, $\text{C}=\text{O}=1.18\pm0.03$ Å., and an angle of $125^\circ\pm5^\circ$ between the linear NCO group and the $\text{C}'\text{N}$ linking assuming a tetrahedral Me, $\text{C}'\text{H}=1.09$ Å., and $\text{C}'\text{N}=1.47$ Å. HNCO has a similar structure, with a linear NCO group and $\text{N}=\text{H}=1.01$ Å. W. R. A.

Dislocations and magnetisation. W. F. Brown, jun. (*Physical Rev.*, 1941, [ii], 59, 528; cf. A., 1941, I, 29).—Mathematical. In continuation of an earlier tentative identification of line consns. of force with the "dislocations" of plasticity theory, it is now shown that the occurrence of the term a/H in the empirical formula, $J = J_s - a/H - b/H^2 + CH$, for the magnetisation curve of Ni at high fields is attributable to internal stresses produced by the dislocations. The increase of a and b with plastic strain is due to the same cause. N. M. B.

Kinetics of the order-disorder transformation in Cu_3Au . S. Siegel (*J. Chem. Physics*, 1940, 8, 860—866; cf. A., 1940, I, 250).—The variation of the elastic modulus S_{11} with time (t), at const. temp. near the crit. temp. (T_c), for a [100] single-crystal of Cu_3Au has been investigated. The isothermals for the transformation from disorder to order superpose on one another if the fraction of untransformed material is plotted against the "reduced time" t/τ , where τ is the time of relaxation. τ decreases rapidly with falling temp. below T_c and probably reaches a min. at $\sim 20^\circ$ below T_c . T_c is $\sim 386.9^\circ$ and 388.0° for the ordering and disordering processes, respectively. The results are in accord with the view that the change from disorder to order proceeds through the formation and growth of nuclei. J. W. S.

Equations of internal equilibrium of theory of elasticity. S. A. Savin (*J. Math. Phys. Mass. Inst. Tech.*, 1941, 20, 13—29).—Solutions of Cauchy and Lamé's equations applicable only to solids free from the action of vol. forces are discussed. L. J. J.

IV.—PHYSICAL PROPERTIES OF PURE SUBSTANCES.

Electrical conductivity of iodine bromide at various temperatures. J. A. Fialkov (*Ber. Inst. Chem. Akad. Wiss. Ukrain.*, 1940, 6, 223—233).—IBr prepared from I and Br had f.p. $40\text{--}41^\circ$. Its conductivity was 0.83×10^{-5} ohm $^{-1}$ cm. $^{-1}$ at 17° , 119×10^{-5} at 65° , and 78×10^{-5} at 110° . The decrease above 65° is presumably due to decomp. of IBr into halogens which reduce the conductivity. J. J. B.

Magnetic properties of potassium molybdocyanide and potassium molybdicyanide. W. A. Rawlinson (*J. Proc. Austral. Chem. Inst.*, 1941, 8, 42—49).— $\text{K}_2\text{Mo}(\text{CN})_8 \cdot 2\text{H}_2\text{O}$ (I) was prepared by reducing MoO_3 in aq. HCl to MoCl_3 with N_2H_4 at $75\text{--}85^\circ$, and digesting with KOH and KCN at 100° . χ_{mol} is -210×10^{-6} for the hydrated complex and -221×10^{-6} for its aq. solution. Anhyd. (I) gives χ_{mol} -78×10^{-6} and its aq. solution gives -132×10^{-6} . The differences produced by dissolution in H_2O are probably due to decomp. rather than to transition of bond type. $\text{K}_2\text{Mo}(\text{CN})_8$ obtained from (I) by oxidation with KMnO_4 can be stored in the dark at 0° . It has the magnetic moment 1.66, corresponding with the spin moment for one unpaired electron. L. J. J.

Magnetism and the third law of thermodynamics. Magnetic susceptibility, adiabatic change of temperature on magnetisation, and heat capacity of $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$. J. W. Stout and W. F. Giaque (*J. Amer. Chem. Soc.*, 1941, 63, 714—722).—The heat capacity of $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$ has been determined by means of an amorphous C thermometer heater from 1° to 15° K. and the adiabatic change of temp. on magnetisation has been measured over the same temp. range in fields up to 8330 gauss. The differential magnetic susceptibility was measured by the method of opposed identical coils and from it the ordinary susceptibility (χ) was calc. χ was also calc. from the thermal data by thermodynamic equations. The electronic system contributes largely to heat capacity at temp. where lattice heat capacity is not important. The heat capacity has max. val. at 1.8° K. Entropy associated with the electronic system amounts to $(R \log_e 3)$, indicating three electronic levels separated from each other by ~ 2.6 cm. $^{-1}$, corresponding with 7.4 g.-cal. per mol. No indication of the existence of electronic entropy is given by the heat capacity curve. Evaluation of the entropy of $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$ by extrapolation would be in error by 2.2 g.-cal. per degree per mol. W. R. A.

Evaporation from earthen jugs. H. L. Gupta, A. C. Jain, and N. N. Khanna (*Indian J. Physics*, 1940, 14, 401—404).—Extension of the theory of the wet-bulb thermometer indicates that the time during which a given quantity of air becomes saturated with H_2O at the temp. of a wet porous jug by contact with it is independent of the temp. of the jug. This is confirmed experimentally. J. W. S.

Crystallisation of water. III. V. Altberg and V. Lavrov (*Acta Physicochim U.R.S.S.*, 1940, 13, 725—729; cf. A., 1940, I, 17).—Experiments illustrating the formation and propagation of ice nuclei in "seeded" supercooled H_2O are described. F. L. U.

Entropy of gaseous diatomic hydrides and halides. D. P. Stevenson (*J. Chem. Physics*, 1940, 8, 898).—The vals. of $S_{298.1}^\circ$ for a large no. of metal hydrides, chlorides, bromides, and iodides have been calc. from the interat. distances and the fundamental frequencies of the mols. J. W. S.

Thermal anomaly in anhydrous copper sulphate. J. W. Stout (*J. Chem. Physics*, 1941, 9, 285).—The heat capacity-temp. curve of measurements at $15\text{--}40^\circ$ K. shows an anomalous max. at 34.8° K. Considerations of magnetic susceptibility data indicate that this max. is associated with the loss of magnetic entropy. Results are discussed in terms of theory. N. M. B.

Determination of specific heat of liquid ethyl chloride and methylene chloride. L. Riedel (*Z. ges. Kälte-Ind.*, 1940, 47, 87; *Chem. Zentr.*, 1941, i, 1801).—Experimental data for the range -48.4° to 45° show that the following expressions are valid, with an accuracy of 0.5%: $C = 0.385 + 0.065 \times 10^{-2} + 0.035 \times 10^{-4} t^2$ kg.-cal. per kg. per 1° for EtCl, and $C = 0.276 + 0.012 \times 10^{-2} t + 0.03 \times 10^{-4} t^2$ kg.-cal. per kg. per 1° for CH_2Cl_2 . R. B. C.

Heat capacities of organic compounds containing nitrogen and the atomic heat of nitrogen. II—IV. S. Satoh and T. Sogabe (*Sci. Papers Inst. Phys. Chem. Res., Tokyo*, 1941, 38, 231—237, 238—245, 246—251).—An extension of previous work (A., 1941, I, 78) in which the at. heat of N is deduced from measured C_p and compared with the val. 4.22 for N in NO_2 -compounds.

II. NH_3 -compounds give 4.04.

III. Pairs of compounds differing by 2N in mol. formulae give 3.78.

IV. Pairs of compounds differing by NH_3 , C_2N_2 , or CN_2H_2 give an average val. of 4.46. W. R. A.

Specific heats at low temperatures of crystalline boric oxide, boron carbide, and silicon carbide. K. K. Kelley (*J. Amer. Chem. Soc.*, 1941, 63, 1137—1139).—The sp. heats of cryst. B_2O_3 , B_4C , and SiC have been measured from 53° to 295° K. and the following vals. of $S_{298.1}^\circ$ have been calc.: B_2O_3 13.0 ± 0.1 , B_4C 6.47 ± 0.07 , SiC 3.95 ± 0.04 , B 1.7 ± 0.2 g.-cal. per degree per mol. W. R. A.

Thermodynamic properties of the hexyl alcohols. VI. β -Dimethylbutan- β -ol and γ -methylpentan- β -ol. F. Hovorka, H. P. Lankelma, and J. W. Bishop (*J. Amer. Chem. Soc.*, 1941, 63, 1097—1098).—V.p., η , ρ_d° , γ , n_D , parachor, Eötvös

const., and total surface energy, are recorded for $\text{CMe}_2\text{Pr}^{\beta}\text{-OH}$ (I) from 5° to 120° and for CHMeEt-CHMe-OH (II) from 5° to 135° . The following vals. for (I) and (II), respectively, are given: b.p. $118.70^\circ \pm 0.02^\circ$, $134.32^\circ \pm 0.02^\circ$; heats of vaporisation 9901 and 10,014 g.-cal.; Trouton const. 25.3 and 24.6. Both alcohols are associated. W. R. A.

Thermal data on organic compounds. XXI. Heat capacity, entropy, and free-energy data for four methylnonanes. G. S. Parks, T. J. West, and G. E. Moore (*J. Amer. Chem. Soc.*, 1941, **63**, 1133—1135).—The heat capacities from 80° to 298° K. of β -, γ -, δ -, and ϵ -methylnonane have been measured; m.p. are 198.8° , 188.5° , 174.7° , 186.7° ; heats of fusion, 29.38 , 31.41 , 25.51 , 27.95 g.-cal. per mol.; $S_{298.1}^\circ$ 100.4, 100.7, 100.3, 101.3 g.-cal. per degree per mol., respectively. $\Delta G_{298.1}^\circ$ vals. for $n\text{-C}_{10}\text{H}_{22}$ and β - and ϵ -methylnonane are: 3480, 1990, and 2180 g.-cal. per mol., respectively, indicating slightly greater stability in the branched isomerides. W. R. A.

Thermal transitions in ammonium and silver trihydrogen paraperiodates. C. C. Stephenson (*J. Chem. Physics*, 1941, **9**, 379).— $(\text{NH}_4)_2\text{H}_3\text{IO}_8$ and $\text{Ag}_2\text{H}_3\text{IO}_8$ show transitions with max. heat capacities at 254.6° K. and 227° K., respectively. The transitions are attributed to re-orientation of the H bonds, and appear to be analogous to the changes observed with KH_2PO_4 and KH_2AsO_4 . $\text{Na}_2\text{H}_3\text{IO}_8$, which has a different external crystallographic symmetry, shows no transition between room and liquid-air temp. J. W. S.

Vapour density of iodine at high temperatures. M. L. Perlman and G. K. Rollefson (*J. Chem. Physics*, 1941, **9**, 362—369).—From measurements of the change in the PV product of I vapour at 723 — 1274° K. it is shown that the vapour comprises I_2 mols. and I atoms in equilibrium, no evidence being obtained for the existence of I_3 . From the equilibrium const. of the reaction $\text{I}_2 \rightleftharpoons 2\text{I}$ and known energy levels of I_2 and I, the following thermodynamic quantities for the dissociation of I_2 are calc.: ΔH_0° $35,514 \pm 50$, $\Delta H_{298.1}^\circ$ $36,057 \pm 50$, and $\Delta F_{298.1}^\circ$ $28,882 \pm 50$ g.-cal. per mol., respectively, and $\Delta S_{298.1}^\circ$ 24.08 entropy units per mol. J. W. S.

Vapour density of hydrazine. P. A. Giguère and R. E. Rundle (*J. Amer. Chem. Soc.*, 1941, **63**, 1135—1137).—The v.d. of 99.4% N_2H_4 has been measured at pressures between 265 and 750 mm. N_2H_4 is not associated in the vapour state, contrary to the results of Eucken and Krome (*Z. physikal. Chem.*, 1940, **B**, 45, 175). W. R. A.

Glass. XVII. Thermal conductivity of glassy and liquid glucose. E. S. Greene and G. S. Parks (*J. Chem. Physics*, 1941, **9**, 262—265; cf. A., 1936, 278).—Coeffs. were measured from -77° to 80° with a concentric-cylinder apparatus. Results show no irregularities or significant change in the "transition" or softening region. N. M. B.

Viscous flow of large molecules. W. Kauzmann and H. Eyring (*J. Amer. Chem. Soc.*, 1940, **62**, 3113—3125).—The statistical mechanical rate equation (cf. A., 1936, 684) is applied in the outline of a general theory of viscous flow in large mols. based on the formation of "holes" through which the unit of flow may pass. The magnitude of the unit of flow is estimated from ΔH vapour/ $\Delta H^\ddagger \sim 3$ or 4 depending whether the mols. are, respectively, spherical or not, ΔH^\ddagger being the heat of activation of the unit of flow. Normal homologous paraffins (C_5 to C_{32}), adipate polymerides, $\mu\text{-S}$, and rubber are examples. The occurrence of non-Newtonian and plastic flow is outlined and discussed qualitatively in terms of the rate equation, particularly with reference to the rupture and re-formation of bonds under different shearing stresses and temp. conditions and thus giving rise to segments of varying length. The η of hydrocarbons containing >14 C in the chain are $<$ would be expected from the simple hole concept, the effect being also exemplified in $\eta = e^{c_1 z^\ddagger}$ (cf. A., 1940, I, 315). The reason appears to be that the random motion of segments of a large mol. must be co-ordinated in order that the mol. can move as a whole in the direction of flow. As the chains lengthen they do not flow as single mols. but as segments ~ 20 atoms in length. The significance of the conclusions reached for the problems of dielectric relaxations and of rates of polymerisation and condensation as a function of mol. size is briefly indicated. W. R. A.

V.—SOLUTIONS AND MIXTURES (INCLUDING COLLOIDS).

Density of perchloric acid solutions. A. E. Markham (*J. Amer. Chem. Soc.*, 1941, **63**, 874—875).—Vals. for ρ_{25}^{25} and ρ_{20}^{20} up to 65 wt.-% of HClO_4 have been determined pyknometrically and the temp. coeff. calc. $\rho_{25}^{25} = 0.99707 + 0.00562796x + 0.0000230045x^2 + 0.00000049593x^3$ ($x = \% \text{ of } \text{HClO}_4$). W. R. A.

Density of aqueous solutions of potassium hydroxide. G. Akerlof and P. Bender (*J. Amer. Chem. Soc.*, 1941, **63**, 1085—1088).—Vals. of ρ for aq. KOH (0.3637—17.8240M) have been measured at 10° intervals from 0° to 70° and vals. of the apparent partial mol. vol. (ϕ) have been calc. The curves of ϕ against \sqrt{m} are continuous; at lower vals. of m , they are practically straight lines and at higher vals. of m fit a quadratic. Equations for computing ϕ are given. W. R. A.

Vapour pressures of aqueous solutions. G. S. Kasbekar (*J. Indian Chem. Soc.*, 1940, **17**, 657—662).—A new method for measuring the v.p. of liquids is described, and v.p. vals. at 25° for solutions of ZnCl_2 , $\text{Ca}(\text{CNS})_2$, $\text{Zn}(\text{CNS})_2$, and H_3PO_4 are tabulated. From these vals. the osmotic pressures, Π , of the solutions have been calc. The very high Π observed with ZnCl_2 , $\text{Ca}(\text{CNS})_2$, and H_3PO_4 are additional evidence for their strong affinity towards H_2O . Π of solutions of $\text{Zn}(\text{CNS})_2$ is \ll that of the other three salts. C. R. H.

Specific heat of solutions of mono-potassium and -ammonium phosphate. N. K. Voskresenskaja and A. P. Rutzkov (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 795—810).—The sp. heat of solutions of KH_2PO_4 and $\text{NH}_4\text{H}_2\text{PO}_4$, containing respectively 0—50 and 0—100 g.-mols. of salt per 1000 g. of H_2O , has been determined at 25° , 50° , and 75° . The partial sp. heat of the H_2O of the solutions is $<$ that of pure H_2O , to an extent rising with increasing concn., and falling with rising temp. R. T.

Specific heat in the ternary system $\text{KH}_2\text{PO}_4\text{-NH}_4\text{H}_2\text{PO}_4\text{-H}_2\text{O}$. N. K. Voskresenskaja and A. P. Rutzkov (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 895—904).—The sp. heat of the solutions has been determined at 20° , 50° , and 75° . R. T.

Thermal diffusion in ternary liquid mixtures, particularly aqueous solutions containing ferrous chloride. L. J. Gillespie and S. Breck (*J. Chem. Physics*, 1941, **9**, 370—374).—The arrangement of Clusius and Dickel (A., 1938, I, 539) has been applied to the study of thermal diffusion in aq. solutions. With aq. glycerol and aq. AcOH , considerable and slight increase of solute concn., respectively, was produced at the colder (lower) end of the apparatus. With aq. AcOH the enrichment was not greatly affected by addition of NaOAc . M-HCl shows very considerable increase of $[\text{HCl}]$ at the cold end, and addition of HCl to 0.5M- FeCl_2 causes the $[\text{Fe}^{++}]$ to increase at the warm end, instead of at the cold end as in the absence of HCl . 0.5M- FeCl_2 in 0.5M- H_2SO_4 shows no increase of $[\text{Fe}^{++}]$ at either end. With 0.5M- BaCl_2 or -ZnCl_2 in M-HCl the $[\text{Ba}^{++}]$ or $[\text{Zn}^{++}]$ increases at the colder end, the effect with ZnCl_2 being $>$ for a solution in 0.01M- HCl . In FeCl_2 enrichment also occurs at the hot end in the presence of HCl , but hydrolysis with the production of a crust which falls to the lower end prevents accurate measurements. The results are discussed theoretically. J. W. S.

Pressure-volume-temperature relations in solutions. V. Energy-volume coefficients of carbon tetrachloride, water, and ethylene glycol. R. E. Gibson and O. H. Loeffler (*J. Amer. Chem. Soc.*, 1941, **63**, 898—906; cf. A., 1939, I, 605).—From measurements of the sp. vol. at 25° of CCl_4 , H_2O , and $(\text{CH}_2\text{-OH})_2$ (I), and of their compressions and thermal expansions, vals. of the vol. at any temp. and pressure within the ranges 25 — 65° and 1 — 1000 bars for CCl_4 , 25 — 105° and 1 — 1000 bars for (I), and 25 — 85° and 1 — 1000 bars for H_2O have been computed. The thermal expansibilities, compressibilities, pressure-temp. coeffs., energy-vol. coeffs., ($C_p - C_v$), and other related data have been computed. CCl_4 behaves as a normal liquid and the energy-vol. coeffs. decrease slightly as temp. increases; this is explained in terms of the effect of change in mol. distribution on the repulsive component of $(\partial U/\partial V)_T$. A pure vol. function, tentatively identified with the attractive component of $(\partial U/\partial V)_T$, is obtained when $(\partial U/\partial V)_T$ is combined with the const. β of

the Tait equation. The energy-vol. coeffs. of H_2O are entirely different, but the differences are explicable by adding a term which gives the change of H-bonding energy with vol. (I) resembles H_2O to some extent. The effect of temp. on the energy-vol. coeff. of the three liquids has been correlated with the variation of C_v with vol. The thermal expansibilities of the three liquids have been compared at const. pressure and at const. vol. W. R. A.

Determination of dipole moments of fatty acids in solution by Drude's second method. M. P. Volarovitch and N. N. Stepanenko (*Acta Physicochim. U.R.S.S.*, 1940, 13, 647—658).—Vals. of μ , determined at $\lambda = 3.5$ m., are recorded for stearic, oleic, and linoleic acids and triolein in solutions of varied concn. The vals. agree with those obtained by other methods. F. L. U.

Dielectric polarisation in solution. II. Polarisation of some alcohols as a function of concentration and temperature. W. H. Rodebush, C. R. Eddy, and L. D. Eubank (*J. Chem. Phys.*, 1940, 8, 889—896).—Dielectric const. and d data are recorded for various solutions of Bu^oOH , *sec.*- $BuOH$, Bu^oOH , cyclohexanol, $OEt\cdot[CH_2]_2\cdot OH$, and $OEt\cdot[CH_2]_3\cdot OH$ in CCl_4 at -10° to 50° . Curves relating the mol. polarisability (A., 1940, I, 284) with the mol. fraction of solute are more readily explained in terms of association than are those showing the apparent mol. polarisation as calc. by the Debye-Clausius-Mosotti method. J. W. S.

Partial pressure of hydrogen bromide from its solutions in some aprotic solvents at 25° . S. J. O'Brien and E. G. Bobalek (*J. Amer. Chem. Soc.*, 1940, 62, 3227—3230).—The partial pressures at 25° of HCl in PhMe (0.015—0.137 m.) and of HBr in C_6H_6 (0.097—0.447 m.), in PhMe (0.185—0.447 m.), in $C_6H_5Me\cdot NO_2$ (0.023—0.323 m.), and in $m\text{-}C_6H_4Me\cdot NO_2$ (0.032—0.449 m.) were measured. All solutions obey Henry's law but show negative deviation from Raoult's law. The mol. solubility of HBr is $>$ that of HCl but the order of solubilities in the four solvents is reversed (cf. A., 1939, I, 564; 1940, I, 316). Equilibrium consts. for the acid-solvent reactions have been calc. The strengths of the two acids are in the same order in H_2O and the hydrocarbons (HBr stronger than HCl) but reversed in $C_6H_5Me\cdot NO_2$. W. R. A.

F.p. and low-temperature viscosities of diacetone alcohol-acetone mixtures. V. Lantz (*J. Amer. Chem. Soc.*, 1940, 62, 3260).—The f.p. of diacetone alcohol (I) is -44.0° . The recorded vals. of -55° and -57° to -54° indicate contamination by 15—20% of $COMe_2$, the most likely impurity. Vals. of η for (I) and for a mixture of (I) and $COMe_2$ are given for the temp. range -2° to -55° . W. R. A.

Glycerol as the standard liquid of high viscosity. J. Tsukamoto and S. Kuriyama (*J. Soc. Chem. Ind. Japan*, 1941, 44, 248).—The η of various glycerol (I)— H_2O mixtures have been measured at 20° with Ostwald viscometers of different bores. Comparisons of analyses of the mixtures and their d_{20}^{20} with literature vals. indicate that the oxidation method of determining (I) is more accurate than the triacetin method. The concn. of a solution of (I) can be determined from the d only, and thus such solutions provide an accurate standard of high η . J. W. S.

Absolute rates of solid reactions. Diffusion. A. E. Stearn and H. Eyring (*J. Physical Chem.*, 1940, 44, 955—980).—Application of the author's theory (A., 1935, 586) of abs. reaction rates to diffusion gives an equation $D = \lambda^2(kT/h)e^{-\Delta F^*/RT}$, where D = diffusion coeff., λ = distance covered in one jump, and ΔF^* = free energy of activation. This is used in a discussion of the diffusion of metals through one another, the diffusion of H in metals, and electrolytic conduction in solids. F. J. G.

Theory of diffusion in liquids. A. E. Stearn, E. M. Irish, and H. Eyring (*J. Physical Chem.*, 1940, 44, 981—995).—The equation given in the preceding abstract is applied to diffusion in liquids, and gives approx. agreement with observation. F. J. G.

Physico-chemical investigation of solutions of aluminium bromide and its complex compounds in several organic solvents. E. J. Gorenberg (*Ber. Inst. Chem. Akad. Wiss. Ukrain.*, 1940, 7, 213—281).—Density, η , and electrical conductivity (κ) are measured for $AlBr_3$ in EtBr and for $SbBr_3\cdot AlBr_3$ in EtBr, C_6H_6 , and PhMe. All the κ -composi-

tion curves show max. In the $AlBr_3$ -EtBr system they are at 62 wt.-% of $AlBr_3$; the max. κ vals. are 26, 30, and 34×10^{-4} ohm $^{-1}$ cm. $^{-1}$ at 0° , 10° , and 20° . In the system $SbBr_3$ - $AlBr_3$ in EtBr the max. κ are 14 and 16×10^{-4} at 0° and 10° , and both at 62 wt.-% of $SbBr_3\cdot AlBr_3$. In the system $SbBr_3$ - $AlBr_3$ in C_6H_6 it is at 71% of $SbBr_3\cdot AlBr_3$ at 10° ($\kappa = 6.5$) and at 77% at 40° ($\kappa = 16.5$). In the system $SbBr_3$ - $AlBr_3$ in PhMe it is at 66% at 0° ($\kappa = 7$) and at 68% at 40° ($\kappa = 18 \times 10^{-4}$). η increases with the wt.-% of salt slowly up to 40—50% and then very rapidly. d increases steadily with the salt concn. The mol. conductivity μ passes through a max. in all these systems but the max. disappears when it is corr. for η ; the corr. μ decreases when the dilution increases (the highest dilution investigated was about 8 l. per mol.); it is almost independent of temp. A steady rise of μ with concn. appears to be the normal behaviour; it is observed also in some aq. solutions (e.g., $AgNO_3$). An interpretation of this fact is given based on the idea that the state of a dissolved substance tends to become identical with that of its melt when its concn. increases. J. J. B.

Physico-chemical study of the systems iodine chloride + metal halides and iodine bromide + metal halides. J. A. Fialkov (*Ber. Inst. Chem. Akad. Wiss. Ukrain.*, 1940, 6, 235—264).—The sp. electrical conductivity κ of ICl at 35° is 5.1×10^{-3} , and of IBr at 45° 6.4×10^{-4} . κ of KBr solutions in ICl was measured up to 12 mol.-% of KBr; it has a max. at 8% (24×10^{-3} at 35° and 30×10^{-3} at 45°). κ of KBr in IBr and of KI in ICl and IBr increases with concn. up to saturation point; at 45° it is 26×10^{-3} for 6.2% of KI in ICl, 33×10^{-3} for 8.8% of KBr in IBr, and 30×10^{-3} for 7.2% of KI in IBr. κ of the $AlBr_3$ -ICl system has a min. at 2 mol.-% of $AlBr_3$, and a max. at 13% (6.9×10^{-3} at 35°); κ of the $AlBr_3$ -IBr system has a max. at 13% (5.4×10^{-3} at 45° and 14.6×10^{-3} at 100°). The last system may be represented as a solution of $IBr\cdot 2AlBr_3$ in IBr or in $AlBr_3$; its mol. conductivity is given by two curves corresponding with two solvents, IBr and $AlBr_3$. Viscosity at 100° of the IBr- $AlBr_3$ system has a max. (0.093 poise) at 55% of $AlBr_3$, and d increases regularly from $AlBr_3$ (2.64 at 100°) to IBr. J. J. B.

Density, viscosity, conductivity, and surface tension of certain binary salt systems. V. P. Barzakovski (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 825—831).—Property-composition curves are given for the molten systems: KCl - $NaCl$ (d and η at 800° and 900° , conductivity κ at 850° , and surface tension γ at 800°), $NaCl$ - $CaCl_2$ (d and γ at 800° and 1000° , η and κ at 800° , 900° , and 1000°), $NaCl$ - $BaCl_2$ (d at 800° and 1000° , η , κ , and γ at 900° and 1000°), and $NaCl$ - $PbCl_2$ (d , κ , and γ at 500° and 600°). R. T.

Effect of composition on refraction and dispersion of glasses.—See B., 1941, I, 226.

Solid solutions of beryllium and magnesium in copper. S. A. Pogodin and I. S. Schumova (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 763—774).—The solid solubility of Be and Mg in Cu, and the hardness and toughness of the alloys, have been determined for systems containing 2.5% Be and 2.8% Mg, at 250 — 800° . The solid solubility of each of these metals is depressed by the presence of the other. All the ternary alloys present the phenomenon of ageing. R. T.

Solubility of beryllium in aluminium. V. I. Micheeva (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 775—782).—The solid solubility of Be rises linearly from 0.005% at 500° to 0.05% at 647° . The hardness of the freshly prepared alloys only slightly exceeds that of Al, but tends to rise with time, owing to ageing. The eutectic alloy, m.p. 647° , contains 0.5% of Be. R. T.

Corrosivity of zinc-magnesium alloys. E. I. Gurovitch (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 929—942).—Alloys containing 0—20 or 80—100% of Zn are resistant to 3% NaCl at room temp.; corrosivity is max. with Zn 52% for 3% NaCl, Zn 20 and 40% for 1% HCl, and Zn 95% for 10% KOH, which does not affect alloys containing 0—80% of Zn. Under conditions of prolonged exposure to the atm. a sharp rise in corrosivity occurs at Zn 82%, corresponding with $MgZn_2$. R. T.

X-Ray study of aluminium-magnesium-calcium alloys rich in aluminium. V. G. Kuznetsov and L. N. Guseva (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 905—928).—At

445° the solubility of Cu in Al falls gradually from 3.1 to 2.5% as the at. ratio Mg : Cu rises from 0 to 1 : 2, and then falls more rapidly to 0.6% as the ratio rises to 7 : 2. Further addition of Mg is without effect. The solubility curve at 500° is very similar to that at 445°. At 400° the solubility of Cu falls steadily with rising [Mg], whilst at 300° and 200° addition of Mg slightly raises the solubility of Cu. The ageing and tempering of duralumin alloys are discussed in the light of these findings. R. T.

Nickel-tungsten system. F. H. Ellinger and W. P. Sykes (*Trans. Amer. Soc. Met.*, 1940, **28**, 619—645).—The alloys were prepared by sintering pressed bars of the mixed powders in H₂. Alloys with <45% of W were hot-rolled at 900—1300°; those containing 25—38% of W were liable to intercryst. cracking, possibly as a result of gas inclusions. The alloys solidify as two solid solutions (α and γ) which form a eutectic at 1495° containing 45% of W. The solidus curve rises to a shallow max. at 1505° and W 35%, before falling to the eutectic temp. A peritectoid reaction occurs between α and γ at 970°, yielding β containing 43% of W. The solid solubility of Ni in W at the eutectic temp. is about 0.3%; that of W in Ni is 39% at 1495°, 37% at 970°, and 25% at 500°. Alloys with 33 to 45% of W age-harden at 600—900°. The 38% alloy retains its hardness to an unusual extent at high ageing temp., and the 35 and 33% alloys appear to age more rapidly at 750° than at higher temp. These features are attributed to the rapid increase in β concn. between 30 and 43% of W and to the influence of the peritectoid reaction on the mechanism of pptn. J. C. C.

Solubility of carbon dioxide in aqueous solutions of sulphuric and perchloric acids at 25°. A. E. Markham and K. A. Kobe (*J. Amer. Chem. Soc.*, 1941, **63**, 1165—1166).—The solubilities of CO₂ in <6M-HClO₄ and in <10M-H₂SO₄ fit the equation $S/S_0 = am + 1/(1 + bm)$ (A., 1941, I, 205) to within ~1%. The equation no longer holds after the solubility passes through the first max. The first min. in H₂SO₄ solution is fitted by the equation. Max. and min. do not correspond with acid hydrates. W. R. A.

System ethyl alcohol-glycerol-benzene at 25°. H. J. McDonald (*J. Amer. Chem. Soc.*, 1940, **62**, 3183—3184).—The solubility relationships, region of immiscibility, and tie lines for the system EtOH-glycerol-C₆H₆ have been determined at 25°, a modified viscosity method being used to analyse the composition of conjugate solutions. W. R. A.

Solubility effect in solvents of low dielectric constant. I. Solubility of tetrabutylammonium iodide in benzene in presence of tetrabutylammonium picrate and nitrate. A. A. Vernon, W. F. Luder, and M. Giella (*J. Amer. Chem. Soc.*, 1941, **63**, 862—864).—The solubility of NBu₄I in C₆H₆ in the presence of the picrate and nitrate has been measured at 25°; it increases rapidly with increasing concn. of the added salt. A brief discussion of the factors likely to contribute to the increase of solubility, even though a common ion is involved, is given. W. R. A.

Solubility in water of nitro-derivatives of phenol and dihydroxybenzenes. N. N. Efremov (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 651—679).—Solubility curves are given for *o*-, *m*-, and *p*-nitro-, 2 : 4-dinitro-, and 2 : 4 : 6-trinitro-phenol, 4-nitro-, 2 : 4- and 4 : 6-dinitro-, and 2 : 4 : 6-trinitro-resorcinol, 3- and 4-nitropyrocatechol, and nitroquinol. R. T.

Solubility of lead iodide in solutions of potassium iodide. Complex lead iodide ions. O. E. Lanford and S. J. Kiehl (*J. Amer. Chem. Soc.*, 1941, **63**, 667—669).—At 25° the solubility of PbI₂ in aq. KI diminishes up to [KI] = 0.01M, and then increases owing to formation of PbI₃⁻ and PbI₄²⁻ ions having stability consts. of 2.22×10^{-5} and 1.42×10^{-4} , respectively. The standard free energy changes, ΔG_{298}° , for $\text{PbI}_{2(\text{solid})} + \text{I}^- \rightleftharpoons \text{PbI}_3^-$ and $\text{PbI}_{2(\text{solid})} + 2\text{I}^- \rightleftharpoons \text{PbI}_4^{2-}$ are 6346 and 5247 g.-cal. per mol., respectively. Pb was determined by measuring the extinction coeff. of the brown PbS solution formed under standard conditions. W. R. A.

Solubilisation of water-insoluble dyes in dilute solutions of aqueous detergents. J. W. McBain, R. C. Merrill, jun., and J. R. Vinograd (*J. Amer. Chem. Soc.*, 1941, **63**, 670—676).—The solubilities at 25° of several H₂O-insol. substances, e.g., Yellow AB (I), chlorophyll, and bile acids, have been measured from both sides of the saturation point in presence of solubilising detergents such as bile salts, soaps, commercial cation-

and anion-active and non-electrolytic detergents. The influence of salts which are non-solubilising but enhance the solubilising property of the detergent causing an increase in solubility is demonstrated. The solubilisation, which is reversible, is separated and distinguished from (i) protective action such as emulsification or peptisation and (ii) the change in solvent medium brought about by substantial additions of a second solvent. The solubilities of (I) in hydrocarbon solvents and soap solution were different. The mechanism of solubilisation is briefly discussed. W. R. A.

Effect of admixtures on mutual solubility of fused salts. V. K. Sementschenko and T. I. Schaschkina (*Compt. rend. Acad. Sci. U.R.S.S.*, 1941, **30**, 126—128).—The effect of admixtures on the mutual solubility of the system KNO₃-TlBr in relation to the magnitude of the generalised moment $m = e/r$ (e = charge, r = radius of ions) has been investigated. The effect was followed by finding the change in the crit. solution temp. caused by the addition of 1 mol.-% of a given salt (Cs, Rb, K, Li, Ba, Sr, Ca, Mg, Be chlorides, and KF, KBr, and KI). The temp. was determined from the change in conductivity, which is very pronounced when the two-phase system becomes a single phase. A. J. M.

Distribution of nicotine between trichloroethylene and water. J. Reilly, D. F. Kelly, and (Miss) M. O'Connor (*J.C.S.*, 1941, 275—278).—The distribution of nicotine between H₂O and C₂HCl₃ at 17° is recorded in diagrammatic and tabular forms. With increase in the amount of nicotine the mutual solubility of H₂O and C₂HCl₃ increases, the solubility of H₂O in C₂HCl₃ increasing more rapidly than that of C₂HCl₃ in H₂O. C₂HCl₃ can be determined by hydrolysis with KOH for 3 hr. at 150° in a sealed tube and determining the Cl. C. R. H.

Adsorption characteristics of gas-promoted nickel. K. Ablesova, S. Roginski, and T. Zelinskaja (*Compt. rend. Acad. Sci. U.R.S.S.*, 1941, **30**, 29—31).—The adsorption curves of A, C₂H₄, C₂H₂, H₂, and H on films of pure Ni and of Ni containing sufficient H₂ or O₂ to give approx. max. catalytic activity for the hydrogenation of C₂H₄ have been compared. Identical isotherms are obtained for both types of film. The velocity of activated adsorption of H₂ or C₂H₄, however, is greater on the promoted than on the unpromoted film. The difference increases with decreasing temp. The velocity of the catalysed C₂H₄ + H₂ reaction is > that of adsorption. L. J. J.

Adsorptive properties of promoted and inactive tungsten layers. M. Babkova and I. Motschan (*Compt. rend. Acad. Sci. U.R.S.S.*, 1941, **30**, 32—36).—Stable promoted W films have been produced by vaporisation of a W filament in presence of Ramsay lubricant vapour. The films retain their catalytic activity for hydrogenation of C₂H₄ after 5 treatments with C₂H₄ + H₂. Adsorption isotherms of A on the promoted and unpromoted films at -195.6° to -183° are approx. identical. Activated adsorption of C₂H₄ and H₂ on the promoted film was >> that on the unpromoted film. L. J. J.

Adsorption of nitrous oxide on certain pseudomorphs. A. B. Lamb and C. D. West (*J. Amer. Chem. Soc.*, 1940, **62**, 3176—3180).—The adsorption of N₂O on the pseudomorphs formed by partly dehydrating cryst. Mg(OH)₂, Ca(OH)₂, Zn(OH)₂, CaSO₄·2H₂O, CuSO₄·5H₂O, KAl(SO₄)₂·12H₂O, Al₂O₃·H₂O (activated) and by partly decarbonating ZnCO₃ and MgCO₃, has been investigated at 0° and compared with similar data for chabasite (I). The adsorptive activity is considerable but << for (I), but as with (I) increases to a max. at 80—90% dehydration and then decreases almost to zero at 100% dehydration. As with (I), the initial removal of H₂O causes the porosity and, consequently, the inner surface area to increase and this continues as long as the residual oxide groups retain their position in the cryst. lattice, whilst at the higher temp. required for complete dehydration, coalescence and probably recrystallisation of the finest constituent particles ensue with a consequent decrease in the inner surface area. X-Ray examination of Mg(OH)₂ in the form of brucite in its various forms of dehydration supports the proposed theory of the adsorption measurements. The optical characteristics of cryst. Zn(OH)₂ are recorded. W. R. A.

Sorption of phosgene by active charcoal. I. Sorption isotherm. K. Arai and S. Fujita (*Bull. Inst. Phys. Chem. Res. Japan*, 1941, **20**, 209—217).—The sorption isotherms of COCl₂ on activated sugar C at 20°, 30°, and 40° have been

determined by a static method over the pressure range 50–760 mm. Empirical equations for the isostere and isobar are given; differential isosteric heats of sorption have been calc. The Langmuir equation is obeyed. W. R. A.

Adsorption of mono- and poly-basic acids by sugar charcoal. K. D. Jain and J. B. Jha (*J. Indian Chem. Soc.*, 1940, 17, 685–690).—Unlike the adsorption by sugar C of mono-carboxylic acids from aq. solutions, which follows the ordinary adsorption laws, di- and tri-carboxylic acids and acid Na and K dicarboxylates show very irregular adsorption, although adsorption generally increases with increasing mol. wt. of the solute. C. R. H.

Influence of salts on the adsorption of strong acids. C. W. Carr, H. Freundlich, and K. Sollner (*J. Amer. Chem. Soc.*, 1941, 63, 693–696).—The change in adsorption of H^+ and OH^- caused by an excess of other inorg. ions on activated and non-activated charcoal has been investigated using mixtures of (i) HCNS with KCNS, NaCNS, LiCNS, KCl, and K_2SO_4 , (ii) HCl with KCl, K_2SO_4 , and KCNS, (iii) H_2SO_4 with KCl, KCNS, and K_2SO_4 , and (iv) KOH with KCl, the concns. of the acids and salts being ~ 0.009 and $0.5N$, respectively. Similar behaviour on both adsorbents was observed. In general the addition of KCNS causes a large increase in adsorption of H^+ whilst the remaining salts cause only a slight increase or decrease. The decrease occurs if the anion of the salt added in excess is less adsorbable than the anion of the pure acid present in a small amount. The addition of KCl to KOH causes an increase in the adsorption of OH^- . In solutions containing K^+ and Cl^- ions no adsorption of these ions could be detected. The assumption that the added salt should cause an increase in adsorption of H^+ due to an electrical effect is untenable and the observed behaviour is explained, for low and moderate salt concn., by assuming that the adsorption of H^+ or OH^- is of paramount importance and is electrically neutralised at the surface of the adsorbent by an equiv. amount of anion or cation, the more adsorbable ion of opposite charge being markedly preferred. The possible formation of ion-pairs on the surface of the adsorbent is briefly discussed. W. R. A.

Adsorption of picric acid by silica gel from mixed organic media. N. F. Jermolenko and Z. M. Avina (*Kolloid. Shurn.*, 1940, 6, 561–568).—In the mixtures $C_6H_5-CCl_4$, $PhMe-CCl_4$, and $COMe_2-CCl_4$ the adsorption regularly increases when $[CCl_4]$ increases, and in the systems C_6H_5-EtOH and $C_6H_5-PhNO_2$ it shows a min. at the ratio 1:1. In all these cases the adsorption increases as the solubility of the picric acid decreases. $C_6H_5-CHCl_3$ mixtures give no definite results. It is concluded that the degree of polarity of the solvent determines the magnitude of the adsorption. J. J. B.

Molecular orientation in adsorption layers and Traube's rule. A. B. Taubman (*Compt. rend. Acad. Sci. U.R.S.S.*, 1941, 29, 210–212; cf. A., 1941, I, 165).—During adsorption from the liquid phase at liquid–gas interfaces, work is considered to be done by the cohesive forces of the solvent in forcing the adsorbed mols. into a flat position in the surface layer and, at higher surface concns., also in forcing a hydrocarbon group out of the surface layer while the polar group remains inside that layer. The difference in the work of adsorption (ΔW) produced by increasing the length of the C chain in the solute by CH_2 is related to the coeff. β in Traube's rule by $\beta = e^{\Delta W/RT}$. The vals. of both β and ΔW for horizontally oriented layers are therefore $<$ for vertically oriented layers. J. W. S.

Methods of determining hydration. I. Analytical and refractometric methods. V. S. Somov (*Kolloid. Shurn.*, 1940, 6, 661–677).—A correct calculation of "bound water" (or negative adsorption) has to take into account dissolution of the adsorbent and adsorption of the "indicator" by it. On the assumption that these corrections are independent of the concn. of the indicator their calculation is possible if results of the negative adsorption at three concns. are given. The equations obtained are applied to the negative adsorption of sucrose, glucose, and $CO(NH_2)_2$ by dried and ground beet-root; the apparent hydration decreases from sucrose to $CO(NH_2)_2$. The adsorption of glucose by starch is positive below 0.05% of glucose and negative at higher concns. High indicator concns. give more trustworthy results than low ones. J. J. B.

Surface activity and adsorption in non-aqueous solutions. A. B. Taubman (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 213–215).—Measurements of the surface tensions of solutions of hydrocarbons, esters of dibasic acids, alcohols, and C_6H_5N derivatives in $PhNO_2$, $1-C_{10}H_7Br$, NH_2Ph , CH_2I_2 , glycerol, and $(CH_2OH)_2$ confirm observations made previously for solutions in $PhNO_2$ and H_2O and are in accord with the author's theory (A., 1940, I, 165; 1941, I, 255). The coeff. β of Traube's rule differs according to the nature of the solute and decreases with decrease of the polar properties of the solvent. J. W. S.

Twin-ring surface tensiometer. I. Apparent surface tension of potassium chloride solutions. M. Dole and J. A. Swartout (*J. Amer. Chem. Soc.*, 1940, 62, 3039–3045).—A new twin-ring tensiometer enabling the error of relative γ measurements to be reduced to 0.002% is described and vals. of γ for 0.0001–1.0N-KCl are recorded. The data confirm the Jones-Ray effect measured by the differential capillary-rise method (cf. A., 1937, I, 126), the min. val. of γ occurring at 0.001N., but the apparent lowering of γ is 0.03% instead of 0.02% as given by Jones and Ray. The agreement in data is so close that the Harkins F -factor (cf. A., 1930, 852) need not be considered. The inapplicability of the Langmuir film theory (cf. A., 1939, I, 140) to the data is demonstrated and the validity of the theory as an explanation of the Jones-Ray effect is considered questionable. W. R. A.

Measurement of boundary tension by the pendent-drop method. I. Aliphatic alcohols. G. W. Smith and L. V. Sorg (*J. Physical Chem.*, 1941, 45, 671–681).—An apparatus designed to obtain photographs of pendent drops from which measurements can be taken for the purpose of calculating boundary energies is described. With its aid the surface tension (γ) of 22 aliphatic alcohols at 25° has been determined. γ of the normal primary alcohols increases with the no. of C atoms, but abnormalities are observed with $MeOH$, $C_8H_{17}OH$, and, to a smaller extent, $C_7H_{15}OH$. The abnormality of $MeOH$ is not surprising since the first member of a homologous series is often not typical, but the abnormality of $C_8H_{17}OH$ is unexplained. Movement of OH from the primary to the sec. C lowers γ by ~ 1 dyne per cm., and changing from a sec. to a tert. C lowers γ by ~ 2 dynes per cm. Branches in the C chain itself lower γ , although $CHMeEt-CH_2OH$ has an abnormally high γ . C. R. H.

Physical properties of fluid interfaces of large radius of curvature. I. Integration of Laplace's equation for equilibrium meridian of a fluid drop of axial symmetry in a gravitational field. Sessile drops of moderately large size. II. Numerical tables for capillary depressions and meniscus volumes in moderately large tubes. III. Sessile drops of large size. B. E. Blaisdell (*J. Math. Phys. Mass. Inst. Tech.*, 1940, 19, 186–216, 217–227, 228–245).—Numerical and analytical integration methods and results, applicable to the evaluation of capillary depression and meniscus vol. with 2% and 0.2% accuracy, respectively, for precise manometry with tubes ~ 20 mm. diameter, and to very large drops, are given. L. J. J.

Critical condition for drop formation and capillary condensation. I. Higuti (*Bull. Inst. Phys. Chim. Res. Japan*, 1941, 20, 130–136).—Theoretical. For the crit. v.p. P for drop formation and capillary condensation the formula $\pm \alpha \gamma = kT \log_e P/P_0$, where α = surface area of a mol., γ = surface tension, k = Boltzmann const., and $P = v.p.$ at temp. T , has been derived thermodynamically. Derived vals. are compared with experimental vals. O. D. S.

Studies of surface properties by the light scattering of deposited liquid films. V. J. Schaefer (*J. Physical Chem.*, 1941, 45, 681–701).—A new method for studying the surface properties of substances is based on the examination of light scattered by monolayers deposited on the substance under investigation. The method renders visible structural and surface characteristics which otherwise are beyond visual inspection or quant. measurement. Thin films of oxidised oil spread on H_2O have been applied to built-up multilayers of acid Ba stearate (Y-type) and analysis of the scattered light has shown that a periodic max. and min. in small-angle light scattering occurs at thickness increments of 16 monolayers, a film of 4, 36, or 68 layers being more oleophobic than a film of 20, 52, or 84 layers. With increasing no. of layers the periodicity loses its sharp detail. Traces of impurity,

e.g., Cu, considerably affect the surface properties. Built-up Cu stearate films do not show the same periodic max. and min. as the Ba stearate films. With neutral Ba or Ca stearate (X-type) multilayers an entirely different sort of relation is obtained. With each successive layer there occurs an alteration in surface properties, and the max. and min. of small-angle scattering correspond with the change in contact angle of large drops placed on the surface. Oil-treated acid Ba stearate films >1 mol. in thickness have a grain-like pattern which is absent in the corresponding Cu stearate films.

C. R. H.

Viscosity of monolayers: a test of the canal viscometer. G. C. Nutting and W. D. Harkins (*J. Amer. Chem. Soc.*, 1940, **62**, 3155—3161).— η of surface films of stearic acid (I) and of penta- (II), hexa- (III), hepta- (IV), and octa (V)-decyl alcohols spread on 0.01N- H_2SO_4 has been measured at 20—25° by several types of canal viscometers. Results are compared with existing data on measurements of η by the torsional pendulum (cf. A., 1938, I, 615). The most satisfactory canal consisted of glass plates with lightly paraffined edges, of which the top edges were at the surface level and the sides, which were hydrophilic, extended considerably below the surface. Canal widths, a , ranged from 0.02 to 0.157 cm. η calc. from the Harkins-Kirkwood equation was not exactly $\propto a^3$ and increased as a increased. η increased approx. linearly with the mean surface pressure (P) of the films. η at P 3 dynes per cm. for (I), (II), (III), (IV), and (V) were 0.00009, 0.00025, 0.00067, 0.00080, and 0.00168 surface poises respectively. The usefulness of the canal viscometer is limited by its inability to indicate changes in η with small changes in film pressure, and it does not give abs. vals. of η . W. R. A.

Monolayers of compounds with branched hydrocarbon chains. III. Evenly distributed methyl side-chains. Phytol and phytanic acid. S. Stållberg and E. Stenhagen (*Svensk Kem. Tidsskr.*, 1941, **53**, 44—51; cf. A., 1940, I, 209; 1941, I, 39).—The areas of monolayers of phytol (I) and phytanic acid (II) have been determined. On 0.01N-HCl at 20° the monolayer of (I) is of the expanded liquid type with a limiting area of 55 Å². Collapse of the layer occurs at 34.5 Å² and 24 dynes pressure. The force-area curve is completely reversible. (II) on 0.01N-HCl at 20° has a limiting area of 63 Å². There is a fairly sharp collapse at 35.5 Å² and 25 dynes pressure. As with (I), the force-area curve is completely reversible. On a neutral substrate there is a contraction of the monolayer, and the limiting area is reduced to 55—56 Å², but the film does not collapse until an area of 30 Å² is reached at 30 dynes pressure. Introduction of Ba⁺⁺ into the substrate causes a further slight contraction, the limiting area being 47.5 Å², but collapse still occurs at 30 Å². In the fully ionised state on 0.01N-NaOH, (II) gives a vapour film. The results are discussed. A. J. M.

Ageing of surfaces of aqueous solutions of ovalbumin. E. A. Hauser and L. E. Swearingen (*J. Physical Chem.*, 1941, **45**, 644—659).—The surface tension (γ) of ovalbumin (I) solutions decreases during ageing, being rapid in the first few min. after the surface has been formed. The decrease is very small for solutions containing 0.001% of (I), a const. val. of ~ 71 dynes per cm. being obtained after 10 min. For all degrees of surface ageing, γ shows a min. val. in the isoelectric zone and γ max. val. at $pH \sim 2.5$. At pH vals. on either side of the isoelectric region (I) exists as a more or less dissociated salt, and the relatively high γ vals. can be attributed to the presence of ions. At lower pH vals. dissociation of the salt is inhibited and γ decreases owing to the absence of (I) salt ions. Successive decreases in γ with age at any given pH are attributed to the effect of H^+ on the rate of coagulation and spreading of the (I) film, whilst the final γ val. depends on the ionic state of the solute. Flask ageing, mechanical agitation, and heating have a negligible effect on γ or on ageing characteristics. C. R. H.

Interactions between polycyclic hydrocarbons and sterols in mixed surface films at the air-water surface. W. W. Davies, M. E. Krahll, and G. H. A. Clowes (*J. Amer. Chem. Soc.*, 1940, **62**, 3080—3098; cf. A., 1940, III, 259).—Surface films at the air- H_2O interface of 9 sterols, a series of mixed films of cholesterol or cholesterol with 35 polycyclic or carcinogenic related hydrocarbons, 3 mixed films with a third component present, 5 sterols and stearic acid mixed with representative hydrocarbons at $\sim 27^\circ$, and 5 mixed films at 8°, 25°, and 40° have been investigated by the manual technique and a new

method employing a kymograph. Most of the hydrocarbons displayed sufficient reactivity towards the sterol mols. to be held between the sterol ring systems. The hydrocarbons are held in the mixed films in two principal ways, in a two-dimensional solution (I) and in association complexes with the sterol mols. (II). In (I) the hydrocarbon mols. may enter or leave reversibly. At any given pressure (P) the solubility depends on the structure of the hydrocarbon and the sterol. The log mol. fraction of the hydrocarbon $\propto P$ below 15 dynes. In (II) the hydrocarbon mol. is held between two appropriately oriented sterol mols. Influences, such as low temp. or a third component, which favour a high degree of orientation of the sterol mols. increase the association. Comparison of the mol. areas of 23 hydrocarbons computed from the difference in areas of the mixed films and the corresponding sterols, and of the 9 sterols, with existing X-ray data shows that the perfection of packing in the film is $<$ in the corresponding cryst. form. The biological consequences of (I) and (II) are discussed. W. R. A.

Critical thickness of the boundary lubricating film for the occurrence of viscous resistance. A. S. Achmatov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1941, **30**, 119—123).—The crit. thickness of a film of myristic acid on steel before viscous resistance commences is $\sim 0.08 \mu$. For high-mol. saturated fatty acids it varies between 0.05 and 0.1 μ . The effective removal of capillary fissures in surfaces by this adsorption layer is considered. A. J. M.

Structure and electrical behaviour of collodion membranes. I. Commercial collodion. K. Sollner, I. Abrams, and C. W. Carr (*J. Gen. Physiol.*, 1941, **24**, 467—482).—The electrochemical "activity" of a collodion membrane depends entirely on the presence of acidic impurities, which probably arise from partial oxidation occurring during manufacturing processes; H_2SO_4 esters play only a small part in the phenomenon. The acid groups, which are built permanently into the collodion surface, determine the behaviour of the membranes in solutions of strong electrolytes. F. O. H.

Theory of renewal dialysis. S. J. Starodubtzev (*Kolloid. Shurn.*, 1940, **6**, 507—521).—If the washing liquid in the dialyser is changed once every t sec., the concn. of the solution after n changes is $c_0\{1 - [u/(u+1)](1 - e^{-ku})^n\}$, c_0 being the initial concn. of the solution, u the ratio of the vols. outside and inside the dialysis membrane, and $k = \beta(u+1)$, β being the characteristic const. of the membrane. The theory is tested on aq. HCl diffusing into H_2O through a collodion bag. The val. of k slowly decreases between two changes of H_2O and is high immediately after renewal. β is const. when u changes in the ratio 1:4. If the total time nt and the total amount of H_2O used are kept const., there is an optimum val. for n . J. J. B.

Capillary analysis in bromatology. Application to the study of fatty materials. R. L. Poch (*Rev. Fac. Cienc. Quím., La Plata*, 1940, **15**, 267—270).—The emulsifying power of 0.5—2% solutions of fatty acids in C_6H_6 with 0.00167—0.002N-NaOH can be determined by measuring the interfacial tension γ of the H_2O - C_6H_6 layers. γ decreases, whilst the emulsifying power increases, with increase in the concn. of the C_6H_6 solution or decrease of that of the NaOH. It is not possible to identify acids by this method. F. R. G.

Thermal conductivity of colloidal systems. B. M. Tarceev (*Kolloid. Shurn.*, 1940, **6**, 545—550).—The thermal conductivity of a system of spheres embedded in a homogeneous medium, calc. by using the analogy between heat and electric currents, is $\lambda[2 + n + 2e(n-1)]/[2 + n - e(n-1)]$, in which λ is the conductivity of the medium, n that of the sphere material, and e is the vol. concn. of the spheres. The equation accounts for published experimental results on asbestos-Bakelite, quartz-resin, and other mixtures. A more exact equation involves the radius of the spheres. J. J. B.

Spontaneous appearance of crystallisation nuclei in the formation of gold sols. R. Wernicke (*Anal. Assoc. Quím. Argentina*, 1940, **28**, 199—212).—From earlier work (A., 1939, I, 563) it is deduced that the prep. of highly dispersed Au sols from dil. $HAuCl_4$ requires the use of (a) a colloidal reducing agent, or (b) a crystalloid reducing agent which can give rise to a colloid under the experimental conditions, or (c) a crystalloid reducing agent in presence of a non-reducing colloid, or (d) a crystalloid reducing agent giving rise to highly dispersed insol. Au compounds, which are subsequently

converted into Au. The reducing action of CO is attributed to the formation of carbonyls. Au sols are formed by the action of alkaline CH_3O , acid or alkaline H_2O_2 in presence of gelatin. EtOH , NH_2OH , HCl , N_2H_4 , H_2SO_4 , and $\text{K}_2\text{C}_2\text{O}_4$ act as reducing agents in presence of nuclei. The activity of the colloidal reducing agents is attributed to their colloidal rather than their protective properties. The formation of nuclei is not spontaneous but requires the pre-existence of a support which can be an absorbent micelle of Au^{+++} or of an insol. Au compound. F. R. G.

Displacement of hydroxyl from aluminium oxychloride hydrosol and basic aluminium chloride solutions. A. P. Tai (*J. Chinese Chem. Soc.*, 1940, 7, 129—137).—The amount of OH^- produced when Al oxychloride sols or basic Al chloride solutions are treated with $\text{K}_2\text{C}_2\text{O}_4$ or KF was determined by titration with HCl . The rise in p_H that follows the addition of these or other neutral salts cannot be attributed to buffer action and it is assumed that OH^- groups are displaced from the Al complexes by the anions of the added salt.

F. L. U.
Preparation and properties of calcium-clay in the state of primary dispersity. V. S. Scharov and V. A. Butovskaja (*Kolloid. Shurn.*, 1940, 6, 587—596).—Primary particles of a Ca-clay are as small as those of a Na-clay, but they form aggregates which are not decomposed by shaking with H_2O . Trituration of wet clay destroys the aggregates, and the proportion of particles <0.001 mm. becomes as high for Ca-clay as for Na-clay (60% as against 9% before trituration). Aggregates formed from these particles in aq. suspension are decomposed by shaking. Before trituration the rates of filtration through Na-, Ca-, and Al-clay are in the ratio 1 : 15 : 50, but after it the clay membrane is water-tight whatever the cation. Suspensions of Ca-clay are called pseudosols, and pastes of it pseudogels; trituration of these produces sols and gels.

J. J. B.
Equivalence of ion exchange in sulphur sols. A. N. Charin, M. H. Juster, and N. J. Agarkova (*Acta Physicochim. U.R.S.S.*, 1940, 13, 715—722; cf. A., 1941, I, 111).—Experiments on S sols prepared by Rafo's method and aged by exposure to sunlight shows exact equivalence between Mg^{++} absorbed and H^+ displaced. Similar experiments with Ba are complicated by the formation of BaSO_4 from SO_4^{--} present in the intermicellar liquid; but when this is allowed for the Ba $^{++}$ absorbed are equiv. to the H^+ displaced. The results are therefore in agreement with those obtained with freshly prepared and purified sols. F. L. U.

Stability of lyophobic colloids. A. I. Baibaev (*Kolloid. Shurn.*, 1940, 6, 621—624).—It is argued that $\text{Fe}(\text{OH})_3$ sol produced by hydrolysis of FeCl_3 is thermodynamically stable since a change of the particle size affects the equilibrium $\text{FeCl}_3 + 3\text{H}_2\text{O} \rightleftharpoons \text{Fe}(\text{OH})_3 + 3\text{HCl}$. Other lyophobic sols can also be equilibrium systems, and lyophilic sols may be unstable. J. J. B.

Silicic acid gels. XI. Effect of concentration of silica on time of set. C. B. Hurd and H. E. Sheffer (*J. Physical Chem.*, 1941, 45, 588—594).—The log time of set (t) of H_2SiO_3 prepared by mixing solutions of Na_2SiO_3 with AcOH decreases linearly with increase in p_H over the p_H range 4.8—6.5 irrespective of temp. or $[\text{SiO}_2]$. For a given temp. and p_H , $t \propto 1/[\text{SiO}_2]^2$. The energy of activation is $\sim 16,500$ g.-cal. and is independent of $[\text{SiO}_2]$. In an earlier paper (cf. A., 1932, 464) it was assumed that the formation of H_2SiO_3 gel resulted from a reaction of the n th order between like mols., and that the process followed the laws of an ordinary chemical reaction. From the present data the val. of n is ~ 3 , but no proof that the reaction is of the third order is available. C. R. H.

Hydrogel of titania. I. Effect of temperature on time of set. C. B. Hurd, W. J. Jacober, and D. W. Godfrey (*J. Amer. Chem. Soc.*, 1941, 63, 723—725).—The prep. of TiO_2 hydrogel is described. The gels are softer than silicic acid gels of equiv. concn. and on keeping yield a granular ppt. which is not due to syneresis. Acidic mixtures set more rapidly with increase of p_H , $[\text{TiO}_2]$, or temp. Gels set at high temp. (80°) can be liquefied on rapid cooling, the effect being reversible. The activation energy determined by three different methods of mixing is 22,000 g.-cal. W. R. A.

Effect of potassium oleate on the solubility of hydrocarbon vapours in water. J. W. McBain and J. J. O'Connor (*J. Amer. Chem. Soc.*, 1941, 63, 875—877).—The solubility of

$\text{iso-C}_4\text{H}_{10}$, butadiene, and propylene in H_2O and aq. K oleate (I) at 25° over the pressure range 0—600 mm. has been investigated. (I) acting as a solubilising detergent enhances the solubility of the hydrocarbons. The negligible effect on the solubility of adding SiO_2 to the (I) solution is demonstrated. Factors influencing detergent action are briefly discussed. W. R. A.

Hydration of curd fibres of sodium palmitate and oleate. J. W. McBain, M. J. Vold, and S. A. Johnston (*J. Amer. Chem. Soc.*, 1941, 63, 1000—1007).—The activity of H_2O as a function of composition in Na palmitate (I) and oleate (II) curds has been determined for (I) by measurements of v.p. at 25°, using a modified isopiestic method, and for (I) and (II) by the amount of ice formed over the temp. range 0° to —30°, using a new dilatometric method. For 100—94, 94—70, 70—60, and 60—0% of (I) and 100—94, 94.5—85, 85—40, and 40—0% of (II), H_2O is contained in the curds as, respectively, (i) H_2O of hydration ~ 1 mol. of H_2O per mol. of soap, and removed only at low R.H. ($<10\%$), (ii) "firmly bound" H_2O , which is removed at R.H. $<87\%$ but only partly removed by freezing at —30°, (iii) "loosely-bound" H_2O which is easily removed by freezing at —1° to —5° or by a moderate lowering of the v.p., and (iv) "free" H_2O which is held mechanically in the capillary spaces between the fibres of the curds, and the activity of which is slightly and progressively lowered by confinement in capillary spaces of $\sim 10^{-4}$ cm. diameter. The activity of systems (i), (ii), and (iii) is not const. at const. temp., and they behave similarly to a one-phase system, whilst (iv) behaves as a two-phase system, small departures arising from confinement of the H_2O in the small capillaries. W. R. A.

Viscosities of polyester solutions and the Staudinger equation. P. J. Flory and P. B. Stickney (*J. Amer. Chem. Soc.*, 1940, 62, 3032—3038).—The relative η of dil. solutions in $(\text{CH}_3\text{CO}_2\text{Et})_2$ at 79° and in PhCl at 25° and 79° of 12 decamethylene adipate polyesters of known wt.-average mol. wt. in the range 1500 to 30,000 have been investigated. For non-homogeneous linear polymerides the η -conc. coeff. at infinite dilution, $[\log_e \eta]_0$, is equal to $K_w M_w + I$, where K_w and I are consts., I being negligible at very high mol. wts. ($>100,000$). In PhCl slight association of the polymeride mols. through the terminal CO groups was observed. Certain deviations from the ordinary Staudinger equation for polymerides of low mol. wt. had been attributed (cf. A., 1934, 283) to association by end groups; by extending the measurements in PhCl to sufficiently dil. solution this theory is not supported. W. R. A.

Solubility curve of high mol. wt. compounds. M. Taniguchi (*J. Soc. Chem. Ind. Japan*, 1940, 44, 85—86B).—An abnormal solubility in $\text{COMe}_2\text{-C}_6\text{H}_5$ mixtures (I) is shown by cellulose acetate samples (Cellit L 1000 and L 700) owing to the existence of mols. of different size and solubility. If the mols. are graded and oriented by slow fractional pptn. from solution a more normal solubility curve in (I) is shown. D. F. R.

Mechanical properties of substances of high mol. wt. I. Photoelastic method for study of transverse vibrations in gels. J. D. Ferry (*Rev. Sci. Instr.*, 1941, 12, 79—82).—Stroboscopic observation of the strain double refraction is used to measure the $\lambda\lambda$ of transverse vibrations in gels at various ν . The modulus of rigidity has been calc. from the velocity of propagation of the vibrations in gelatin, collagen, fibrin, and myosin gels, the vals. varying from 300 to 13,000 dynes per sq. cm. J. W. S.

Coagulation of pectic substances at various p_H values. T. K. Gaponenkov and F. L. Movschovitsch (*Kolloid. Shurn.*, 1940, 6, 537—539).—Aq. solutions of hydratopectin (I) from beetroot, made acid or alkaline by HCl or NaOH , were pptd. by an $\text{Et}_2\text{O-EtOH}$ mixture. The most complete coagulation ($>99\%$) took place at p_H 4.8, at the same acidity the η of a 2% solution of (I) showed a max. It is known that the rates of hydrolysis and peptisation of pectin show a min. at this acidity. (I) exerts a slight buffering action. J. J. B.

Some fruit and berry juices regarded as colloid systems. A. M. Kuschneruk (*Kolloid. Shurn.*, 1940, 6, 523—530).—Sols of apple pectin are negative. The rate of their electrophoresis is low in H_2O at p_H 4.5, high when succinic acid is added to p_H 3, and low again at p_H 2. K citrate promotes the increase of rate caused by 0.1 g. of succinic acid per 100

c.c. of sol. Electrical conductivity increases on addition of BaCl_2 . Relative viscosity is reduced by small additions of NaCl (electroviscous effect); addition of COMe_2 up to 20% does not affect it, but it is reduced by higher concns. (dehydration effect). J. J. B.

Movement of peat mass in open beds. N. N. Kulakov and K. I. Samarina (*Kolloid. Shurn.*, 1940, 6, 597–602).—The movement of peat suspensions (containing ~4% of solids) in an inclined open channel can be expressed by the equation $u = C(\sqrt{Ri} - \sqrt{Ri_0})$, u being the average speed of flow, i the slope of the channel, R its hydraulic radius, and C and i_0 are const. The val. of C is for peat suspensions 5–10% > that of H_2O ; i_0 is 0 for H_2O but has a measurable val. for suspensions corresponding with the "yield val." of viscosity when measured in capillaries. If the depth of liquid in the channel, i.e., the hydraulic radius, is varied, the product Ri_0 remains almost const. J. J. B.

Thermodynamic properties of large molecules. R. E. Powell, C. R. Clark, and H. Eyring (*J. Chem. Physics*, 1941, 9, 268–273).—The interpretation of flow of linear polymerides by a theory of motion of segments (cf. Kauzmann, A., 1941, I, 249) provides an explanation of the change of m.p. with chain length, the abnormally large increase in the osmotic pressure of large linear polymerides with concn., their abnormally large solvent v.p. above concn. solution, the fact that surface tension becomes independent of mol. wt. for long mols., and the vol. and entropy changes in the swelling of polymerides. The theory for the effect of concn. of solvent is developed and segment lengths are calc. All effects indicate segment lengths of ~20 atoms. N. M. B.

Anomalous dispersion and dielectric loss in polar polymerides. J. G. Kirkwood and R. M. Fuoss (*J. Chem. Physics*, 1941, 9, 329–340).—Mathematical. A theory of dielectric loss of polar polymerides at high dilution in a non-polar plasticiser is developed. The theory predicts a broad distribution in relaxation times, associated with the internal rotatory Brownian motion of the C chain, and an approx. relationship between the degree of polymerisation, frequency of max. loss, and the viscosity coeff. of a polar plastic is derived. Loss factors for a monodisperse polymeride and for a polydisperse polymeride with exponential distribution of chain-length are derived. For polyvinyl chloride in Ph_2 the calc. loss is of the same order as but > the observed vals. The discrepancy is probably due to neglect of chain interaction effects and of chain branchings in the theoretical treatment. J. W. S.

Ageing of sols and gels. IX. Ageing of hydrosols of various resins. E. M. Preis (*Kolloid. Shurn.*, 1940, 6, 569–574).—The hydrosols were prepared by mixing 1 c.c. of an EtOH or COMe_2 solution of the resin with 99 c.c. of H_2O . The opalescence O of the hydrosols increases with increase in the concn. of the EtOH solution (1–5%). The O of mastic sols is increased greatly, and that of Novolac sols slightly, by storage for up to 30 days. Resol (a phenol- CH_2O resin) sols are very unstable. Novolac sols prepared from a solution in COMe_2 are more stable than those from EtOH solution. Novolac particles grow by coalescence, as distinct from condensation of dissolved mols. on the particles; this is shown by the absence of a max. of O at an intermediate [EtOH], whereas the O of mastic has a max. in 9% EtOH. A rise of temp. greatly increases the O of mastic and even more that of colophony, but scarcely affects that of Novolac. For 0.4 g. of resin in 1 l. of sol coagulation is caused by 2.5 m-mol. per l. of BaCl_2 for colophony, 2.25 for mastic, 1.0 for Novolac from COMe_2 , and 0.25 for Novolac from EtOH. J. J. B.

Water bound to gelatin as shown by molecular structure studies. O. L. Sponsler, J. D. Bath, and J. W. Ellis (*J. Physical Chem.*, 1940, 44, 996–1006).—Consideration of the possible modes of association of H_2O with the polar groups of a protein mol. leads to the expectation of a max. of ~35% of bound H_2O for gelatin, in agreement with physicochemical evidence, and provides an interpretation of changes of intermol. spacings on progressive dehydration. The view that the H_2O is bound by means of H bonds accords with infra-red absorption spectra. F. J. G.

Physical-chemical investigation of certain nucleoproteins. II. General electrophoretic behaviour. J. L. Hall (*J. Amer. Chem. Soc.*, 1941, 63, 794–798; cf. A., 1940, II, 317).—The

nucleohistone, H_2O - and aq. NH_3 -sol. nucleoproteins of the calf thymus, and the hog thyroid nucleoprotein are of uniform electrophoretic behaviour. The isoelectric point is near p_H 4, exact determination being impossible because of limited solubility. p_H -mobility curves in acetate and phosphate buffers at 25° and 0.7° are given and the average mobilities computed. Average mobilities \gg those of the usual non-conjugated proteins in the p_H ranges 2–3.5 and 5–9 have been observed. The corresponding thymonucleic acid and histone have been prepared and are electrophoretically homogeneous. The histone is insol. at its isoelectric point (p_H ~12). W. R. A.

State of dispersion of gelatin in concentrated potassium thiocyanate solutions. E. O. Kraemer (*J. Physical Chem.*, 1941, 45, 660–670).—The form of the η -concn. curves for solutions of gelatin (I) in ~2M-KCNS resembles similar curves for solutions of linear macromols. showing no gelation tendencies. KCNS completely represses those temp.-sensitive aggregation forces that otherwise lead to gelation. The sedimentation const. falls regularly with increasing concn. of (I), this also being typical of linear macromols. The mol. wt. and frictional ratio calc. from the sedimentation and diffusion const. are additional evidence that (I) disperses as single mols. in such solutions. Although the mols. are folded and coiled to approx. one fifth the extended length, they are more extended and rod-like than those of any other proteins hitherto studied. C. R. H.

Heat of swelling of gelatin in relation to the p_H of the medium. I, II. T. V. Ass, N. I. Putilin, and L. N. Raevskaja (*Kolloid. Shurn.*, 1940, 6, 639–643, 645–648).—I. The heat of mixing of gelatin containing 0.8% of ash and 15% of H_2O with dil. HCl at 40° has a max. (1.8 g.-cal. per g.) at p_H 2 and a min. at p_H 4.3.

II. The heat of mixing of gelatin containing 0.8% of ash and 8% of H_2O with HCl at 21° has a max. (16 g.-cal. per g.) at p_H 2 and a min. at p_H 4.8. J. J. B.

Importance of various sterols for the swelling of gelatin. D. N. Matrosovitch (*Kolloid. Shurn.*, 1940, 6, 575–582).—The swelling of 40% gelatin gels containing 5% of sterol was determined in glycine, citrate, and phthalate buffers. It is slightly higher than that of pure gelatin for purified cholesterol, higher for cholesterol + lecithin, and very high for crude cholesterol from brain. Metacholesterol is inactive, allocholesterol behaves like cholesterol, and isocholesterol causes very strong swelling. Hydroxycholesterol, cholesterol oxide, and cholestenone are only slightly active. Cholestenone is the most active sterol; at p_H > 8 swelling leads to dissolution. Cholesteryl esters show small effects in the order stearate > palmitate > oleate. J. J. B.

Solvation of prolamines in alcohol-water mixtures. V. A. Vilenski and V. A. Pavlova (*Kolloid. Shurn.*, 1940, 6, 607–620).—10% solutions of maize zein in aq. alcohols were brought into equilibrium with aq. alcohols through collodion membranes, and the apparent adsorption Γ of the alcohol by zein was calc. from the change of the concn. of the outside solution. Γ is positive for dil., and negative for concn. solutions of EtOH and Pr^nOH ; the curve Γ -wt.-concn. is almost linear between 50 and 80% of EtOH and between 40 and 70% of Pr^nOH . Both these regions are identical with those of the solubility of zein. Presumably in these regions zein is saturated with both alcohol and H_2O ; it is assumed that zein contains separate adsorption centres for these substances. $\Gamma = 0$ at 67% of EtOH, at which concn. it is calc. that 1 g. of zein adsorbs 0.34 g. of H_2O and 0.77 g. of EtOH. At 63% of Pr^nOH , in which also $\Gamma = 0$, the corresponding adsorptions are 0.37 and 0.63 g. The osmotic pressures of zein solutions (0.5–1.9%) in 56% and 67% EtOH are identical, showing that the solvation does not change within the linear range of the Γ curve. The Γ of $\text{MeOH-H}_2\text{O}$ mixtures is negative at small and positive at high [MeOH]; presumably MeOH and H_2O mols. compete for the same adsorption centres in zein. J. J. B.

Electrokinetics. J. D. Quist and E. R. Washburn (*J. Amer. Chem. Soc.*, 1940, 62, 3169–3172).—Sedimentation potentials (E) (Dorn effect) of 40–50-mesh Pyrex glass in H_2O and in 1×10^{-4} to $5 \times 10^{-4}\text{M-} \text{AlCl}_3$, -BaCl_2 , and -NaCl , using a new type of fall tube with AgCl electrodes, have been measured. E for H_2O is positive and, in accord with theory, directly \propto the wt. of glass falling between the electrodes. The behaviour in the salt solutions is in accord

with the Hardy-Schulze rule. In $5 \times 10^{-6}M$ - $AlCl_3$ E becomes negative owing to Al ions reversing the sign of the charge on the glass. The ζ -potentials for the glass- H_2O interface are ~ -0.110 and -0.102 v. 80—150-mesh PbS is negative in H_2O . W. R. A.

Variation of the ζ -potential of some colloids in water-alcohol-ether mixtures. I. A. J. Schtschelkanovtzeva (*Kolloid. Shurn.*, 1940, 6, 649—659).—Electro-osmosis through filter-paper was measured in a closed apparatus, using chiefly Pt electrodes. No movement is observed with Et_2O . In H_2O - $EtOH$ and Et_2O - $EtOH$ mixtures the rate of flow increases with $[EtOH]$. For the system H_2O - $EtOH$, but not for Et_2O - $EtOH$, this change agrees with the variation of the mol. polarisation of the mixture. It is assumed that $EtOH$ dipoles form the double layer at the paper-liquid boundary to the exclusion of Et_2O dipoles. The electro-osmosis through paper impregnated with $Fe(OH)_3$ sol is stronger than through paper alone; the ζ -potential is only slightly affected by variation of the composition of the liquid, except at higher concns. of Et_2O which would be sufficient to coagulate the $Fe(OH)_3$ sol. J. J. B.

Electro-osmotic phenomena involving metal hydroxides. I. I. Shukov and Z. D. Pigareva (*Kolloid. Shurn.*, 1940, 6, 491—506).—Suspensions of metal hydroxides were centrifuged; from the sediments membranes were prepared, and the supernatant liquid was electro-osmotically pressed through them. The electrokinetic potential was calc. without considering the surface conductivity. The membranes were positive when the hydroxides were pptd. in the presence of an excess of MCl_2 or $M(NO_3)_2$; they were negative but became positive after washing out when prepared with excess of $NaOH$ or MSO_4 . The charge reversal on washing out was more thoroughly investigated for $Mg(OH)_2$ than for $Co(OH)_2$, $Ni(OH)_2$, $Cu(OH)_2$, $Cr(OH)_3$, and $Al(OH)_3$. When the pH of the liquid was changed by HCl or KOH , the charge reversal of $Mg(OH)_2$ took place at pH 11.4—11.8. J. J. B.

Preparation of periodical sediments by electrolytic coagulation of a gelatin sol containing cadmium sulphide. F. D. Ovtsharenko (*Ber. Inst. Chem. Akad. Wiss. Ukrain.*, 1940, 6, 307—310).—When 1 c.c. of 1N- $NaCl$ is put on top of 10 c.c. of 0.02M- CdS sol in a test-tube coagulation takes place in separate layers. Periodical sediments are also produced when 0.5M- CdS in 1% gelatin sol is coagulated by 0.01—1M- $FeCl_3$ placed on top of the sol. $NaCl$, $BaCl_2$, etc. may be used instead of $FeCl_3$. J. J. B.

VI.—KINETIC THEORY. THERMODYNAMICS.

Acid-base equilibria in methyl alcohol. M. Kilpatrick and W. H. Mears (*J. Amer. Chem. Soc.*, 1940, 62, 3047—3051; cf. A., 1939, I, 199).—The effect of ionic strength (μ) on the equilibrium consts. for the reaction between bromocresol-blue (I) or bromocresol-green (II) and *o*-, *m*-, and *p*-Cl-, -Br-, -F-, - NO_2 -, -Me-, -OMe-, and -OH-derivatives of benzoic acid in MeOH from 22.0° to 29.3° for (I) and from 21.5° to 23° for (II) has been investigated. Two methods of extrapolation to infinite dilution for thermodynamic equilibrium consts. are given and compared. Observed and calc. vals. of the equilibrium consts. are in good agreement. The order or decreasing acid strength of the substituted acids relative to $BzOH$ in H_2O and MeOH has been determined from existing data. On passing from H_2O to MeOH the ratio of the strengths increases generally for *m*- and *p*- but decreases for *o*-substituted acids. Better agreement of observed and calc. vals. of the equilibrium consts. is found in H_2O than in MeOH and it is thought this may be due to a larger partial mol. vol. in H_2O than in MeOH. W. R. A.

Acid-base equilibria in ethyl alcohol. M. Kilpatrick and W. H. Mears (*J. Amer. Chem. Soc.*, 1940, 62, 3051—3054; cf. preceding abstract).—An extension of previous work to $EtOH$ at ionic strengths <0.02 . A linear relationship between the log of the relative acid strength (I) and the reciprocal of the dielectric const. (ϵ) in the solvents MeOH, H_2O , and $EtOH$ (except for the OH-substituted acids) is established. For *o*- NO_2 -, -I-, -Br-, -Cl-, and -Me-, I decreases with decreasing ϵ but increases for *o*-F-, -OMe-, and -OH-substituted benzoic acid. For *m*- and *p*-substituted acids I increases with decreasing ϵ except for OMe- and Me derivatives. The intrinsic acid strengths have been determined by extrapolation. W. R. A.

Incomplete dissociation in solutions of strong electrolytes. K. Fajans (*J. Chem. Physics*, 1941, 9, 283; cf. A., 1941, I, 244).—Plotted data for alkali halides indicate that the change of apparent mol. vol. in concentrating the solution is due not only to the screening of the field of the ions but also to an individual effect caused by their interpenetration. N. M. B.

Thermodynamic ionisation constants of sulphurous acid at 25°. H. V. Tartar and H. H. Garretson (*J. Amer. Chem. Soc.*, 1941, 63, 808—816).—Vals. of the first and second ionisation consts. (K_1 and K_2) of H_2SO_3 at 25° have been computed from measurements of the e.m.f. of the cells $Ag, AgCl, NaCl (m_1), NaHSO_3 (m_2), SO_2 (dissolved) (m_3), glass, buffer, AgCl, Ag, and Ag, AgX (X = Cl, Br), NaX (m_1), Na_2SO_3 (m_2), NaHSO_3 (m_3), glass, buffer, AgX, Ag$, respectively. $K_1 = 1.72 \times 10^{-2}$, $K_2 = 6.24 \times 10^{-8}$. The cause and prevention of abnormal behaviour of the glass electrode in presence of SO_3^{2-} solutions are discussed. From investigation of the solubility of $AgCl$ in Na_2SO_3 a new complex ion $Ag(SO_3)_2^{2-}$ has been detected. W. R. A.

Ionisation constants of oxalic acid at 25° from conductance measurements. L. S. Darken (*J. Amer. Chem. Soc.*, 1941, 63, 1007—1011).—Ionisation consts. (K_1, K_2) of $H_2C_2O_4$ at 25° have been determined by application of a modified conductance method (cf. A., 1940, I, 256) to aq. $H_2C_2O_4$ and aq. $Na_2C_2O_4$. K_1 and K_2 are 5.36×10^{-2} and 5.3×10^{-6} , respectively. Vals. of limiting equiv. conductances are: $Na_2C_2O_4$, 124.25 and, for the primary ionisation of $H_2C_2O_4$, 390.0. W. R. A.

Ionisation of lactic acid in aqueous sodium chloride solutions from 0° to 37.5°. F. C. Hickey (*J. Amer. Chem. Soc.*, 1940, 62, 2916—2919).—Accurate measurements of the e.m.f. of the cells $H_2|lactic\ acid (m), NaCl (m')|AgCl-Ag (m = 0.2-0.5M; m' = 0.1-2.0M)$ have been made at 0°, 12.5°, 25°, and 37.5°. From results and existing data (cf. A., 1933, 781) the ionisation const. (K_A), the activity coeffs. of the acid in salt solutions, and the temp. variation of ionisation at all salt concns., have been computed. A method for evaluating the apparent ionic diameter (a in the Debye-Hückel theory), which in the calculation of K_A was found to vary, is suggested. W. R. A.

Dissociation constants in the cinnamic acid series. R. D. Kleene, F. H. Westheimer, and G. W. Wheland (*J. Amer. Chem. Soc.*, 1941, 63, 791—793).—The dissociation consts. in 40% $COMe_2$ of *cis*-, *trans*-, and six substituted cinnamic acids have been determined; they cannot be explained on the basis of inhibition of resonance in those acids which cannot possibly have a planar configuration. W. R. A.

Conductivity and dissociation constants of amino-acids in alcoholic solution. J. N. Beliaev (*Kolloid. Shurn.*, 1940, 6, 531—535).—Solutions in MeOH having a sp. conductivity of 6×10^{-7} are used. The apparent dissociation consts. K_a increase with the concn. c according to $\log_e K_a = \log_e K + f\sqrt{c}$. The extrapolated const. K is 11×10^{-5} , 8×10^{-5} , 6×10^{-5} , and 3.5×10^{-5} for α -amino-isovaleric and -butyric acid, *m*- and *p*- $NH_2 \cdot C_6H_4 \cdot CO_2H$, respectively. J. J. B.

Interaction of ions and dipolar ions. I. Solubility of barium and calcium iodates in glycine and in alanine solutions. R. M. Keefer, H. G. Reiber, and C. S. Bisson. II. Solubility of silver and lead iodides in glycine and in alanine solutions. R. M. Keefer and H. G. Reiber (*J. Amer. Chem. Soc.*, 1940, 62, 2951—2955; 1941, 63, 689—692).—I. The solubilities of $Ba(IO_3)_2$, $Ba(BrO_3)_2$, and $Ca(IO_3)_2$ in glycine (I) and alanine (II) solutions and of $Ba(IO_3)_2$ and $Ca(IO_3)_2$ in (I) containing KCl have been determined. The effects of ionic strength and of dipolar ions on the solubility of the iodates are independent and additive. The solubilities of the iodates in (I) obey the Kirkwood limiting law up to 0.15M. From the slopes of the solubility curves and crystal radii vals. of the dipole radii of (I) and (II) of the correct order of magnitude have been calc. from the Kirkwood equation.

II. The curves obtained by plotting the log of solubility of $AgIO_3$ or $Pb(IO_3)_2$ in (I) or (II) solutions against NH_2 -acid concn. have abnormal slopes which are attributed to the formation of complex ions between Ag^+ or Pb^{2+} and glycinate or alaninate ions. The following dissociation consts. ($\times 10^5$) have been obtained: Ag glycinate 5.28, Ag alaninate 1.37, Pb glycinate 0.67, Pb alaninate 0.30. W. R. A.

Association of phenols. W. H. Rodebush and C. Kretschmer (*J. Chem. Physics*, 1941, 9, 284).—Studies of the dielectric polarisations of solutions of alcohols in CCl_4 (cf. A., 1941, I, 251) show that the total polarisation curves of PhOH at low temp. are anomalous, indicating that association is $<$ that of the alcohols, but infra-red data show that it should not be of a different order of magnitude. Association of PhOH by the bringing together of two OH groups may be reduced by resonance. N. M. B.

Hydrogen bonds involving the C-H linking. XI. Effect of structure on bonding of donor and acceptor molecules. XII. The C-H \cdots F linking. C. S. Marvel, M. J. Copley, and E. Ginsberg (*J. Amer. Chem. Soc.*, 1940, 62, 3109–3112, 3263–3264; cf. A., 1940, I, 438).—XI. Heats of mixing of a donor and an acceptor mol. have been measured at 3° for 63 mixtures, in 23 of which CHCl_3 is acceptor. Br is slightly less effective than Cl in promoting acceptor activity in neighbouring H atoms. I is practically ineffective. $(\text{CHCl}_2)_2$ is a very effective acceptor but CCl_2CHCl is much less so. Evidence for the association of $\text{CH}(\text{OEt})_2$ and $\text{CH}_2(\text{OEt})_2$ is given.

XII. If F atoms have donor properties association through C-H \cdots F linkings occurs in CPhF_3 . If these bonds are broken to form more stable C-H \cdots N or C-H \cdots O linkings the heat of mixing of CPhF_3 with donor solvents should be $<$ that of CPhCl_3 . This is borne out for N compounds by determination of the heats of mixing at 3° for equimol. mixtures of CPhF_3 and CPhCl_3 with NMe_2Ac and dimethylcyclohexylamine, but with the O compounds, Et_3PO , Et_2O , and COMe_2 , vals. are less conclusive, possibly because p -hydrogens of the ring are not sufficiently activated to form C-H \cdots O linkings of strength $>$ that of the C-H \cdots F linkings. W. R. A.

Activity coefficient of calcium nitrate in aqueous solution at 25° from isopiestic vapour pressure measurements. R. A. Robinson (*J. Amer. Chem. Soc.*, 1940, 62, 3130–3131).—Isopiestic v.p. measurements on aq. $\text{Ca}(\text{NO}_3)_2$ and aq. KCl have been made at 25° and osmotic and activity coeffs. of $\text{Ca}(\text{NO}_3)_2$ from 0.1 to 3.0M. have been evaluated.

W. R. A.

Activity coefficients of lithium, sodium, and potassium sulphate and sodium thiosulphate at 25° from isopiestic vapour pressure measurements. R. A. Robinson, J. M. Wilson, and R. H. Stokes (*J. Amer. Chem. Soc.*, 1941, 63, 1011–1013).—Osmotic and activity coeffs. of aq. Li_2SO_4 , Na_2SO_4 , $\text{Na}_2\text{S}_2\text{O}_3$, and K_2SO_4 at 25° have been determined by isopiestic v.p. measurements, using KCl. Vals. for K_2SO_4 , Na_2SO_4 , and Li_2SO_4 agree within $\sim 0.7\%$ with vals. derived from existing e.m.f. data. The val. for $\text{Na}_2\text{S}_2\text{O}_3$, using Na_2SO_4 as a subsidiary standard, is 0.455 at 0.1M. Activity coeff. curves of the four salts lie below that of $\text{Ca}(\text{NO}_3)_2$ and correspond with vals. of closest distance of ionic approach of ~ 3 –4 Å. The extent of ionic association is discussed. W. R. A.

Activity coefficients of sodium and potassium thiocyanate in aqueous solution at 25° from isopiestic vapour pressure measurements. R. A. Robinson (*J. Amer. Chem. Soc.*, 1940, 62, 3131–3132).—Solutions of NaCNS and KCNS have been compared with KCl at 25° by isopiestic v.p. measurements and their activity coeffs. from 0.1 to 4.0M. and from 0.1 to 5.0M., respectively, have been evaluated. W. R. A.

Thallous chloride-ethyl alcohol-water system at 25°. Activity coefficients of thallous chloride in ethyl alcohol-water mixtures. E. Hogge and A. B. Garrett (*J. Amer. Chem. Soc.*, 1941, 63, 1089–1094).—The solubility of TlCl in 10, 30, 40, 51.25, and 60% EtOH has been determined at 25° and also the influence of added KCl on the solubility. ρ_{\pm}^{obs} for all solutions has been measured. Activity coeffs. of TlCl in each solvent, corr. for incomplete dissociation, have been calc. over a range of ionic strength. The solubility of TlCl as a function of the dielectric const. agrees with the prediction of the Born equation in order of magnitude, but shows increasing deviation as the dielectric const. decreases.

W. R. A.

Heating curves of sulphates of bivalent metals. L. G. Berg and A. V. Nikolaev (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 865–876).—The heating curves of the salts $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, $\text{MSO}_4 \cdot 7\text{H}_2\text{O}$ ($\text{M} = \text{Ni}, \text{Co}, \text{Fe}, \text{Zn}, \text{Mg}$), and $\text{MnSO}_4 \cdot 5\text{H}_2\text{O}$ are each characteristic of the given salt, but all have certain features in common. The curves have three halts, due respectively to (i) dissolution of salt in H_2O of crystallisation,

(ii) evaporation of saturated solution, and (iii) elimination of the last mol. of H_2O of crystallisation. In addition to these, exothermic effects due to oxidation are evident with MnSO_4 and FeSO_4 . $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ and $3\text{CdSO}_4 \cdot 8\text{H}_2\text{O}$ give somewhat different curves, associated with special properties of these salts. R. T.

Solid transformations in the system K_2CO_3 – Na_2CO_3 . S. Z. Makarov and M. P. Schulgina (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 691–703).— K_2CO_3 yields an uninterrupted series of solid solutions with Na_2CO_3 ; min. m.p. is 706° (40 mol.-% of K_2CO_3). Each component exists in four modifications, α , β , γ , and δ , transition points 618°, 486°, and 356° for Na_2CO_3 , and 622°, 438°, and 250° for K_2CO_3 , respectively. The mutual solid solubility of the α - and β -modifications is unlimited, that of the γ - and δ -modifications limited. A 1:1 compound is confirmed. R. T.

Liquid-vapour composition of the boiling ternary solution ethyl alcohol-glycerol-benzene. H. J. McDonald (*J. Physical Chem.*, 1941, 45, 706–715).—B.p. isotherms for the system EtOH-glycerol- C_6H_6 have been determined from liquid-vapour composition data and are presented in a triangular diagram. When EtOH distils from the ternary solution the mol. fraction of EtOH in the vapour equals that in the liquid, and is practically const., the mol. fractions of glycerol and C_6H_6 in condensate and residue adjusting themselves to maintain the constancy. The b.p. curve for the system EtOH-glycerol has been obtained. C. R. H.

Fractional crystallisation. Mathematical analysis of fractional crystallisation problems in n -component systems. H. J. Garber and A. W. Goodman (*J. Physical Chem.*, 1941, 45, 573–588).—The quant. effect of evaporating solvent from a solution at const. temp. has been considered in a general manner. C. R. H.

Polyiodides of sodium. I. System sodium iodide-iodine-water. T. R. Briggs, W. F. Geigle, and J. L. Eaton (*J. Physical Chem.*, 1941, 45, 595–613).—An exhaustive isothermal and polythermal survey of the system NaI – I – H_2O has been made. Three polyiodides of apparent formulae $\text{NaI}_{1.13}$, 13 – $15\text{H}_2\text{O}$, $\text{NaI}_{1.17}$, 17 – $19\text{H}_2\text{O}$, and $\text{NaI}_{1.20}$, 10 – $11\text{H}_2\text{O}$ have been obtained. No evidence of a solid tri-iodide has been obtained. In the main the data agree with those of Cheesman *et al.* (cf. A., 1940, I, 361). Considerable doubt is cast on the data of Plotnikov *et al.* (cf. A., 1935, 584) on the conductivity of solutions of NaI in liquid I. C. R. H.

Polyiodides of rubidium. II. F.p., solubility, and b.p. relationships in the system rubidium iodide-iodine-water at approximately standard pressure. T. R. Briggs, C. C. Conrad, C. C. Gregg, and W. H. Reed (*J. Physical Chem.*, 1941, 45, 614–639).—The complete polythermal phase diagram of the system RbI – I – H_2O has been determined from the lowest eutectic to the b.p. of the saturated liquids. The existence of anhyd. RbI_3 has been proved. The greater part of the b.p. diagram at 740–750 mm. has been analysed as a special phase-rule problem involving three components of which two are volatile. More complete data for the system RbI – H_2O are presented. The work of Fialkov (cf. A., 1936, 1197) on the system RbI – I is adversely criticised. C. R. H.

Preparation of potassium polyiodide from the system potassium iodide-iodine-benzene. J. A. Fialkov and A. B. Polischtschuk (*Ber. Inst. Chem. Akad. Wiss. Ukrain.*, 1940, 7, 95–104).—To a saturated solution of I in C_6H_6 KI was gradually added at room temp., and the composition of the sediment determined. Two compounds were found, viz., $\text{KI}_3 \cdot \text{C}_6\text{H}_6$, and $\text{KI}_5 \cdot 2\text{C}_6\text{H}_6$; polyiodides containing more I were not investigated. J. J. B.

Solubility diagram of the system K_2CO_3 – Na_2CO_3 – H_2O and the separation of potassium and sodium carbonates. S. Z. Makarov and M. P. Schulgina (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 511–528).—The solid phases are $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$, $\text{K}_2\text{CO}_3 \cdot \text{Na}_2\text{CO}_3$ (I), and $\text{K}_2\text{CO}_3 \cdot 5\text{H}_2\text{O}$ (II) at 120°, Na_2CO_3 (I), and (II) at 140°, and Na_2CO_3 and (II) at 145°. 97% K_2CO_3 is obtained by crystallisation at $>140^\circ$. R. T.

Carbamide. V. System $\text{Ca}(\text{NO}_3)_2$ – $\text{CO}(\text{NH}_2)_2$ – H_2O . W. Sakai (*J. Soc. Chem. Ind. Japan*, 1940, 43, 394B; cf. A., 1941, I, 116).—Diagrams at 25°, in wt.-%, and mol.-%, are given. The only double salt formed is $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{CO}(\text{NH}_2)_2$. D. F. R.

(A) Double salts of mono- and di-potassium phosphate. L. G. Berg and G. B. Boki. (B) Heating curves of potassium phosphates. L. G. Berg (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 877—885, 887—894).—(A) The following double salts are formed in the system $K_2O-P_2O_5-H_2O$, at 25° and 50°: $5K_2HPO_4 \cdot KH_2PO_4 \cdot 2H_2O$, $3K_2HPO_4 \cdot KH_2PO_4 \cdot 2H_2O$, $2K_2HPO_4 \cdot KH_2PO_4 \cdot H_2O$, $K_2HPO_4 \cdot KH_2PO_4 \cdot 2H_2O$, $K_2HPO_4 \cdot KH_2PO_4 \cdot 3H_2O$. Solubility and crystallographic data are recorded for these salts.

(B) Heating curves are recorded for the salts $K_3PO_4 \cdot 3H_2O$, $K_2HPO_4 \cdot K_2HPO_4 \cdot 3H_2O$, $K_2HPO_4 \cdot K_2P_2O_7$, KPO_3 , KH_2PO_4 , H_3PO_4 , $H_3PO_4 \cdot 0.6H_2O$, and the above double salts. R. T.

Chemical method of isolation of tin from its chlorides. G. G. Urazov and M. A. Sokolova (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 739—750).—The fusion diagram of the system $Zn-SnCl_2$ is given. The reaction $Zn + SnCl_2 \rightarrow Sn + ZnCl_2$ proceeds rapidly to completion at 400°, to yield a layer of $Sn-Zn$ and an upper layer of $ZnCl_2$. Heating of the alloy with $SnCl_2$ converts it into pure Sn . At 450° the reaction $SnCl_2 + 2Zn \rightarrow Sn + 2ZnCl_2$ takes place, whilst at lower temp. $SnCl_2$ is formed as an intermediate product.

R. T.

Phase-rule diagram for a mixture of sodium palmitate and sodium laurate with water. J. W. McBain and S. A. Johnston (*J. Amer. Chem. Soc.*, 1941, 63, 875).—Const. mixtures of equal wt. of Na laurate and palmitate with different % of H_2O have been investigated by heating to 300° in sealed glass tubes and allowing to cool slowly. The temp. at which phase separation begins and curdiness occurs are recorded. The occurrence of the shorter laurate mols. among the higher homologues gives rise to mixed micelles of smaller size, less orientation, and greater solubility (due to mutual solubilisation) than palmitate micelles.

W. R. A.

System $Na_2CO_3-NaHCO_3-Na_2SO_4-NaCl-H_2O$, in the region of crystallisation of natron. S. Z. Makarov and G. S. Sedelnikov (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 835—863).—The system has been studied at 20°, 25°, 30°, 35°, 45°, and 60°. The solid phases are $Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$ (I), $Na_2CO_3 \cdot 10H_2O$, Na_2SO_4 , $Na_2SO_4 \cdot 10H_2O$, $2Na_2SO_4 \cdot Na_2CO_3 \cdot NaHCO_3$, and $NaCl$. Conditions for crystallisation of (I) together with each of the other solid phases have been defined. Conditions of crystallisation of (I) from the brine of certain Siberian salt lakes have been studied in the light of the above data.

R. T.

Heat of dilution of aqueous hydrochloric acid at 25°. J. M. Sturtevant (*J. Amer. Chem. Soc.*, 1940, 62, 3265—3266).—Corrections to published data (A., 1940, I, 218).

W. R. A.

Heats of dilution, relative molal heat contents, and heat capacities of aqueous sodium sulphate solutions. W. E. Wallace and A. L. Robinson (*J. Amer. Chem. Soc.*, 1941, 63, 958—963).—Intermediate heats of dilution of aq. Na_2SO_4 have been measured at 15° and 20° for 0.0001—0.4M. and at 25° for 0.1—0.4M. Apparent relative heat contents, relative partial mol. heat contents, and partial mol. heat capacities have been obtained and are in reasonable agreement with recorded data.

W. R. A.

Heat of neutralisation of sodium hydroxide with hydrochloric acid. G. Kegeles (*J. Amer. Chem. Soc.*, 1940, 62, 3230—3232).—Separate recorded heat data for aq. $NaOH$, HCl , and $NaCl$ at 25° have been combined to give the deviations of the heat of neutralisation from its val. at infinite dilution. Vals. of the heat of neutralisation per mol. of reacting acid and base have been deduced for integral molalities from 1 to 16.

W. R. A.

Thermodynamic properties of vapours.—See B., 1941, I, 195.

Thermodynamic formulation of the water relations in an isolated living cell.—See A., 1941, III, 468.

VII.—ELECTROCHEMISTRY.

Conductance of electrolytes. IX. Use of the cathode-ray oscillograph as a detector. G. Jones, K. J. Mysels, and W. Juda (*J. Amer. Chem. Soc.*, 1940, 62, 2919—2922; cf. A., 1939, I, 309).—The utilisation of the cathode-ray oscillograph instead of the telephone as a detector for precision measurements of Λ of electrolytes is described. A sensitivity of 0.001% was obtained with 500—5000 cycles per sec., and of

0.002% with up to 13,000 cycles. The method possesses the following advantages over the telephone: (i) observation is visual, (ii) resistance and capacitance balance of the bridge can be made substantially independent, (iii) outside disturbances are more easily traced and eliminated, (iv) measurements are possible over a greater range of frequency, (v) harmonics and transients can be seen as such, and (vi) progressive or periodic changes in conductance due to chemical reactions or temp. fluctuations can be followed more easily.

W. R. A.

Conductivity isotherms of binary liquid systems. M. A. Klotschko (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 629—649).—The shape of the curves depends on the relative conductivity of the components, on whether compounds are formed, and on their nature, and on the η of the systems.

R. T.

Temperature coefficient of conductance of potassium chloride in H_2O-D_2O mixtures. V. K. LaMer and F. C. Nachod (*J. Chem. Physics*, 1941, 9, 265—268; cf. A., 1935, 1078).—The temp.-dependence of the equiv. conductance Λ of 0.02M-KCl was studied at 5°, 25°, and 45° as a function of D content of the solvent. The curve at 5° and 45° is similar to that for 0.01M-KCl at 25°. Although Λ in pure D_2O decreases to 83% of the H_2O val., the Walden product $\Lambda\eta$ (η = relative viscosity of solvent) remains almost const. It increases slightly but linearly with the D fraction F_D from 138.5 to 141.1 at 25°, and behaviour is similar at 5° and 35°. The temp. coeffs. of conductance for 5—25° and 25—45° increase linearly and in parallel with F_D , corresponding with 8.1% and 5.7%, respectively, on passing from H_2O to D_2O .

N. M. B.

Electrolytic study of indium trichloride in acetone. A. T. Nishnik (*Ber. Inst. Chem. Akad. Wiss. Ukrain.*, 1940, 6, 291—305).—The sp. electrical conductivity κ of $InCl_3$ in $COMe_2$ has a max. (144×10^{-4} at 18°) at 8.4 mol-% of $InCl_3$; κ was measured up to 17.8% of $InCl_3$, where it was 84×10^{-4} . The mol. conductivity increases with dilution in a normal way. The temp. coeff. of κ is positive; between 4° and 40° it is 5×10^{-3} for 0.36%, 11×10^{-3} for 7%, and 20×10^{-3} for 11% of $InCl_3$. Electrolysis of these solutions with Cu cathodes produces a glossy deposit of In; the best c.d. is 6 amp. per sq. dm. The decomp. potential of 11% $InCl_3$ in $COMe_2$ is 2.2 v.

J. J. B.

Physico-chemical analysis of fused salt systems. I. Conductivity of binary systems of nitrates, chlorides, and iodides of sodium, potassium, thallium, mercury, and silver. A. G. Bergman and I. M. Tschagin (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 727—738).—Conductivity-composition curves are given for the systems $NaNO_3-KNO_3$ (250—500°), HgI_2-HgCl_2 (200—300°), $-TiNO_3$ (225—300°), and $-AgNO_3$ (125—275°), and $TiNO_3-HgCl_2$ (200—275°). Formation of compounds is indicated by sharp rational min. on the curves. The curves tend to flatten with rising temp.

R. T.

Magnitude of the surface conductivity at aqueous-glass interfaces. H. L. White, F. Urban, and B. Monaghan (*J. Physical Chem.*, 1941, 45, 560—573).—The a.c. sp. surface conductivity of unpolished Pyrex glass in contact with various concns. of KCl has been redetermined, duplicating the technique of McBain and Foster (cf. A., 1935, 705). Earlier vals. of the authors (cf. A., 1932, 699), which are ~0.05 of McBain's vals., have been confirmed. With KCl concns. as high as those employed in obtaining McBain's data reproducible results could not be obtained.

C. R. H.

Antimony electrode. Normal electrode potential. Potential of the antimony electrode as a function of hydrogen-ion concentration. F. Hovorka and G. H. Chapman (*J. Amer. Chem. Soc.*, 1941, 63, 955—957).—The Sb electrodes, prepared by electrolysis of pure $SbCl_3$ from HF solution, were free from surface pitting and had high lustre, and were cleaned by electrolysis in Na_2CO_3 . The normal electrode potential (E) is 0.2552—0.5893 p_H at 25° relative to the normal H electrode. At p_H between 2.2 and 8 the slope of the curve is a const. of val. 0.05893, which is very close to the theoretical val. of 0.05912.

W. R. A.

Potential of $Cu|Cu'$ in liquid ammonia. V. A. Pleskov (*Acta Physicochim. U.R.S.S.*, 1940, 13, 659—661; cf. A., 1936, 161).—The normal potential of the $Cu|Cu'$ electrode, calc. from measurements of the e.m.f. of the cell $+Cu|0.1N-Cu||$ saturated $NaNO_3|0.1N-Pb(NO_3)_2|Pb-$ with liquid NH_3 as solvent, is 2.34 v. ($Rb = 0$).

F. L. U.

Electrode potentials in anhydrous hydrazine. V. A. Pleskov (*Acta Physicochim. U.R.S.S.*, 1940, 13, 662—676).—Normal potentials of Li, Na, K, Rb, Ca, Zn, Cd, Pb, H, Cu, and Ag are calc. from measurements of their e.m.f. against H in 0.1N-N₂H₄.H₂SO₄ in anhyd. N₂H₄. The elements named fall into three groups, viz., (1) alkali metals and Ca, having potentials almost the same as those in H₂O, (2) Zn, Cd, Pb, for which the potentials in N₂H₄ are displaced by 0.5—0.8 v. to the less noble side compared with those in H₂O, and (3) H, Cu, Ag, where a similar but larger (up to 1.22 v.) displacement is observed. The displacements are attributed to interaction between the H or metal ions and the solvent (solvation and complex formation). The dissociation of anhyd. N₂H₄ was determined and is given by [N₂H₅⁺][N₂H₄⁻] ~ 2 × 10⁻²⁵. F. L. U.

Variation of the potentials of lead in sulphuric acid solutions. D. P. Sosimovitsch (*Ber. Inst. Chem. Akad. Wiss. Ukrain.*, 1940, 6, 211—222).—The change in time of the e.m.f. of cells Hg, Hg₂SO₄|H₂SO₄|Pb is determined for 4 concns. of H₂SO₄. In the first few min. up to a few hr. the Pb potential (referred to H₂ electrode) becomes less noble, and then stays const. at -0.32 to -0.34 v. for 75, 175—200, 450—500, and 600—650 hr. when the H₂SO₄ is 7.5, 6.1, 4.8, and 2.2N., respectively; this represents the duration of sulphate formation. During the third stage the potential becomes positive (~0.33 v.); this stage occupies ~100 hr. After that the potential remains almost const. for as long as a year. When, in an accumulator, Pb is in contact with H₂SO₄ its surface slowly becomes positive but, since the acid is used up for the sulphate formation, the concn. of H₂SO₄ diffusing into the bulk of the Pb plate is < that on the surface; the deep layers remain longer negative and impress a negative potential on the whole plate. J. J. B.

Potentials of iron-chromium alloys containing hydrogen. H. H. Uhlig, N. E. Carr, and P. H. Schneider (*Trans. Electrochem. Soc.*, 1941, 79, Preprint 16, 209—217).—The equilibrium potentials of Fe-Cr alloys in O₂-free 4% NaCl are active at [Cr] > ~11.5% and passive above this concn. When cathodic H₂ diffuses from an alloy face not in contact with NaCl the potentials become more active, especially in the case of passive alloys. Relative passivity of alloys containing interstitial H₂ persists, the crit. [Cr] increasing to 15%. Recently pickled Fe and stainless steels are chemically active on account of dissolved H₂. The relatively long time necessary to establish Fe or alloy equilibrium potentials depends on the rate of formation of hydroxide film and on the rate at which interstitial H₂ comes into equilibrium with the external solution. It is probable that lattice-dissolved H₂ increases the free energy change and the corresponding electrode potential of the reaction Fe → Fe²⁺ + 2e and of similar reactions for alloy constituents. There is a delay of min. or hr. between the discharge of cathodic H₂ on one side of a specimen and a change in potential on the other side, especially for samples which have not been pickled. This delay is a measure of the time for H₂ diffusion. C. R. H.

Electromotive forces in molten chlorides of aluminium and sodium. V. A. Plotnikov, E. I. Kiritschenko, and N. S. Fortunatov (*Ber. Inst. Chem. Akad. Wiss. Ukrain.*, 1940, 7, 159—172).—A glass U-tube containing a sintered glass filter in the middle was filled with an equimol. mixture of NaCl and AlCl₃; an Al and a metal (M) electrode were immersed in the mixture, and some M chloride was added to it near the M electrode. The e.m.f. of such cells increases with temp. (400—600°) and with the concn. of M chloride (except MnCl₂). For the ratio M:Al = 1:10 the e.m.f. are: Zn|ZnCl₂ at 365° 0.36 v., Cu|CuCl at 500° 0.81 v., Cu|CuCl₂ at 500° 0.84 v., Mn|MnCl₂ at 500° 0.12 v., and Fe|FeCl₃ at 500° > 1 v. All these metals are nobler than Al. J. J. B.

Hydrogen overvoltage. J. A. V. Butler (*J. Chem. Physics*, 1941, 9, 279—280).—A criticism of Eyring (cf. A., 1940, I, 75) and Kimball (cf. A., 1941, I, 170). N. M. B.

Hydrogen overvoltage at high current densities. II. Influence of the solvent. A. Hickling and F. W. Salt (*Trans. Faraday Soc.*, 1941, 37, 224—231).—H overvoltage (η) measurements in the c.d. range 10⁻³—1.0 amp. per sq. cm. have been made in N-HCl solutions in (CH₃OH)₂, and in some cases in EtOH and cyclohexanol, for Hg, W, platinised Pt, Sn, and Pb. In no case is η in the alcoholic solvent < in H₂O, and the shapes, slopes, and positions of the η-log c.d.

curves are similar to those in aq. solution (cf. A., 1941, I, 50). Although the nature of the solvent may cause minor variations due to secondary influences it is considered that η is not primarily determined by the environment of the H ion. F. L. U.

Electrochemical polarisation. New method for measuring rates of polarising reactions. Diffusion process. A. E. Lorch (*Trans. Electrochem. Soc.*, 1941, 79, Preprint 14, 199—204).—The reaction of O₂ on H₂ electrodes is diffusion-controlled, since the rate of the reaction remains const. as the activity of the catalyst decreases. Experiments with bright Pt, Pt-black, and bright Ir, in which the observed O₂ diffusion rates agree with calc. vals., show that diffusion is the limiting rate factor in these reactions. C. R. H.

Vitamin-E. XXIX. Behaviour of compounds related to vitamin-E at the dropping mercury electrode. L. I. Smith, I. M. Kolthoff, S. Wawzonek, and P. M. Ruoff (*J. Amer. Chem. Soc.*, 1941, 63, 1018—1024).—Current-voltage curves and half-wave potentials are recorded for three 6-hydroxy-chromans (A) and five 5-hydroxycoumarans (B) in buffered 50% MeOH; they are independent of concn. Similar data are recorded for 26 quinones and quinols; the half-wave potentials agree closely with standard oxidation potentials. Half-wave potentials for (A) are 10 mv. more positive than those of (B); (A) and (B) are thus readily distinguishable; they can be determined polarographically. A reaction mechanism is discussed. R. S. C.

Reduction of oxygen at the dropping mercury electrode. I. M. Kolthoff and C. S. Miller (*J. Amer. Chem. Soc.*, 1941, 63, 1013—1017).—In the reduction of O₂ at the dropping Hg electrode in air-saturated 0.1M-KCl and 0.1M-KNO₃ at 25°, using a new dipping type of saturated calomel electrode, two O₂ waves were observed which correspond with (i) the reduction of O₂ to H₂O₂ and (ii) the reduction of H₂O₂ to OH⁻. No relationship appears to exist between p_H and the half-wave potentials of (i) and (ii), and the slopes of both waves correspond with irreversible reactions. The O₂ max. in (i) is readily suppressed by traces of thymol and methyl-red. The formation of OH⁻ in (ii) is demonstrated by measurements on air-free and air-saturated solutions of 0.001M-HCl, in 0.1M-HCl with a trace of methyl-red, of 0.001M-CdCl₂ in 0.1M-KCl and in 0.1M-HCl, and of 0.0009M-Pb(NO₃)₂ in 0.1N-KNO₃ and in 0.1N-HNO₃. The addition of Fe(CN)₆⁴⁻ or the citrate ion has no greater effect on the "positive" O₂ max. than has Cl⁻ or NO₃⁻, in contradiction to the Heyrovsky rule. The diffusion coeff. of dissolved O₂ at 25° is 2.6 × 10⁻⁵ cm.² per sec. W. R. A.

Use of the dropping mercury electrode as an indicator electrode in poorly poised systems. I. M. Kolthoff and E. F. Orlemann (*J. Amer. Chem. Soc.*, 1941, 63, 664—667).—Oxidation potentials of poorly poised (buffered) systems can be determined with the dropping Hg electrode, provided that the anodic residual current is estimated correctly. Measurements with 0.1M-KNO₃, 0.001M-quinol and 0.001M-quinhydrone are described. The surface [H⁺] produced at the dropping Hg electrode during electrolysis has been calc. by considering the diffusion and current relationships. Derived equations are in good agreement with experimental results. W. R. A.

VIII.—REACTIONS.

Combustion of methane: displacement of mixtures giving maximum flame velocities. A. R. T. Denues and W. J. Huff (*J. Amer. Chem. Soc.*, 1940, 62, 3045—3047).—The effects of the [O₂] in the combustion of CH₄ on flame velocities and on the displacements of mixtures giving max. flame velocities have been measured. A regular relationship between the displacement and [O₂] has been established in contrast with other available data. The max. flame velocity for CH₄ in O₂ is 320 cm. per sec. W. R. A.

Kinetics of oxidation of hydrocarbons. R. A. Day, jun., and R. N. Pease (*J. Amer. Chem. Soc.*, 1941, 63, 912—915).—Cool-flame and ignition regions and rates of slow oxidation of n-C₇N₁₆, ββ-trimethylbutane, iso-C₈H₁₈ (I), C₈Me₈ (II), C₈H₈, cyclohexane, cyclopropane (III), C₃H₈ (IV), C₃H₆ (V), propylene oxide, and (CH₂)₂O by O₂ in the temp. range 270—600° and at 100—600 mm. pressure have been measured by a static method. Essentially the same order of reactivity as in the order of crit. compression ratios in internal-combustion

engines is observed in the cool-flame and ignition measurements and in the slow oxidation process. (I) and (II) behaved similarly. (III) was resistant to oxidation, gave no cool flames, and the ignition temp. were $>$ and the rates of oxidation $<$ for either (IV) or (V). W. R. A.

Periodicity law. P. I. Petrenko-Kritschenko and V. E. Herschel (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 460—461; cf. A., 1938, II, 167).—Vals. are recorded for the % decomp. after 120 and 300 min. of *o*-, *m*-, and *p*-C₆H₄Cl·CH₂Cl, -C₆H₄Cl·CHCl₂, *m*- and *p*-C₆H₄Cl·CCl₃, -NO₂·C₆H₄·CH₂Cl, and NO₂·C₆H₄·CHCl₂, in 0.05M-EtOH solution, by 0.05M-KOH, -NaOEt, -NH₃, -AgNO₃, and H₂O, at 70°. The relative reactivities are similar to those for similar compounds without nuclear substitution. The no. of halogen atoms in the side-chain influences the reactivity $>$ the orientation of the nuclear substituent. A. J. E. W.

Steric inhibition of resonance. II. Rates of reaction of nitro- and cyano-aryl halides. W. C. Spitzer and G. W. Wheland (*J. Amer. Chem. Soc.*, 1940, 62, 2995—3002; cf. A., 1940, II, 270).—The rates at which a series of NO₂- and CN-aryl compounds, with Br in the *o*- or *p*-positions to the NO₂ or CN groups, react with piperidine and/or OH⁻ ion have been determined. Resonance can be inhibited to a slight extent in the NO₂- but not in the CN-compounds by the introduction of Br. The inhibition from existing dipole data (cf. A., 1937, II, 92) should be nearly complete and the smallness of the effect observed is thought possibly due to the chemical reactivity of the compounds being less sensitive to a moderate inhibition than is the dipole moment. The prep. of *p*-piperidinobenzonitrile, m.p. 55°, is described. W. R. A.

Kinetic principles of the method of isotopic indicators. I. Kinetics of exchange reactions. S. Z. Roginski (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 601—616).—A classification of reactions involving exchange of isotopes is given, and a theoretical study is made of the kinetics of such reactions. R. T.

Lower limit for velocities of formation of trihalide ions in aqueous solution. R. S. Halford (*J. Amer. Chem. Soc.*, 1940, 62, 3233—3236).—Various mechanisms for the Cl₂-Cl' interchange reaction are considered and it is concluded that the mechanism involved is essentially the formation and decomp. of Cl₃'. Similar mechanisms in Br₂-Br' and I₂-I' reactions are probable. Lower limits are established at 17° for the velocity coeffs. of (i) formation of Cl₃': $k > 4 \times 10^5$ l. mole⁻¹ min.⁻¹, and (ii) decomp. of Cl₃': $k > 4 \times 10^7$ l. mole⁻¹ min.⁻¹. The lower limit holds for the velocities of formation of Br₃' and I₃', the order of the sp. velocities being I₃' $>$ Br₃' $>$ Cl₃', but the sp. velocities of decomp. are not necessarily in this order. W. R. A.

Change of velocity of the reaction between hydrogen peroxide and hydriodic acid through displacement of protium by deuterium atoms. T. L. Chang and Y. C. Wei (*J. Chinese Chem. Soc.*, 1940, 7, 138—143).—The time of the first 10% of the reaction between HI and H₂O₂ was measured at 20° in aq. solutions containing various amounts of D₂O. Extrapolation of the results to 100% D₂O indicates that the velocity of the reaction between D₂O₂ and I' in D₂O is 0.60 of that of the reaction between H₂O₂ and I' in H₂O. F. L. U.

Kinetics of oxidation of organic compounds by potassium permanganate. III. Formic acid. D. R. Mann and F. C. Tompkins (*Trans. Faraday Soc.*, 1941, 37, 201—209; cf. A., 1940, I, 415).—The oxidation of HCO₂H by aq. KMnO₄ in solutions of low acidity is kinetically of the second order, and there is no induction period. The rate-determining process is a bimol. collision between HCO₂' and MnO₄'. The mechanism suggested by the results is: MnO₄' + HCO₂' → MnO₃' + CO₂ + OH', followed by the faster reactions 2MnO₃' + H₂O → MnO₂ + HMnO₄' + OH' and HMnO₄' + HCO₂' → MnO₂ + CO₂ + 2OH'. The heat of activation is 11.2 kg.-cal. F. L. U.

Hydrolysis of methyl acetate in a non-aqueous solvent. H. B. Friedman and G. V. Elmore (*J. Amer. Chem. Soc.*, 1941, 63, 864—866).—The hydrolysis of MeOAc in COMe₂ with only sufficient H₂O present to effect hydrolysis has been investigated at 25°; the reaction is of the second order. W. R. A.

Kinetics of transformation of comminuted bodies. S. Z. Roginski and O. M. Tedes (*Bull. Acad. Sci. U.R.S.S., Cl. Sci.*

Chim., 1940, 475—491).—The effect of particle size of dispersed bodies on the kinetics of reactions affecting them is discussed, for reactions involving or not involving nucleus formation. In general the velocity of a reaction will be greater for mono- than for poly-disperse systems of the same max. particle size. R. T.

Burning of carbon. IV. Oxidation of a charcoal layer. Z. F. Tschuchanov and N. A. Karshavina (*Fuel*, 1941, 20, 44—47, 73—77; cf. B., 1939, 683).—Data on the rate of oxidation of a layer of charcoal in a current of air at 1150—1600° with rates of gas flow of 0.2—35 m. per sec. are consistent with the theory that the reaction occurs according to either (1) 2C + O₂ = 2CO or (2) 4C + 3O₂ = 2CO + 2CO₂. Under the conditions mentioned the second reaction is predominant and proceeds in the stages (2a) 3C + 2O₂ (adsorbed) = C₃O₄, (2b) C₃O₄ + C + O₂ (from the gas) = 2CO + 2CO₂, and (2c) C₃O₄ = 2CO + CO₂. At [O₂] $>$ 1.0—1.5% the process is largely determined by (2a), which is of zero order as regards O₂; at [O₂] $<$ 1.5% (2b) and (2c) play an important part. The activation energy of (2) is ~20,000 g.-cal. The relation between the measured reaction const. (K₀) and the linear rate of gas flow (V) is expressed by K₀ = kV^{0.4}. The results are in accord with those obtained from the oxidation of suspensions of charcoal in air. A. B. M.

Velocity of reduction of silver chloride by hydrogen and deuterium. F. Ishikawa and K. Yoshimura (*Bull. Inst. Phys. Chem. Res. Japan*, 1941, 20, 201—208).—The velocity of reduction of AgCl in the presence of a large excess of AgCl by H₂ and D₂ has been studied by measuring the pressure increase at const. vol. The difference between the apparent heats of activation for H₂ and D₂ is 4.1 kg.-cal. but this includes an unknown heat quantity due to adsorption of H₂, HCl, D₂, and DCl. The difference in the velocities of reduction of H₂ and O₂ is attributed chiefly to the differences in the zero point energies. The reaction is retarded by strongly adsorbed HCl. W. R. A.

Mechanism underlying initiation of explosion in a condensed phase.—See B., 1941, I, 248.

Solid free radical as catalyst for ortho-para hydrogen conversion. J. Turkevich and P. W. Selwood (*J. Amer. Chem. Soc.*, 1941, 63, 1077—1079).—The magnetic susceptibilities at various temp. of *aa*-diphenyl-β-picrylhydrazyl (I), the corresponding hydrazine, and active (II) and ignited ZnO have been determined by the Gouy method. The adsorption of H₂ at liquid air temp. on (I), (II), and an intimate 1:1 mixture of (I) and (II) has been measured. The ortho-para conversion at liquid air temp. was slow on (I) and on (II) but very rapid on an intimate mixture. W. R. A.

Catalytic properties of beryllium chromite. R. K. Ladisch and J. C. W. Frazer (*J. Amer. Chem. Soc.*, 1940, 62, 3222—3227).—A Be chromite (I) catalyst has been prepared by thermal decomp. of Be(NH₄)₂(CrO₄)₂ at 250° in a vac. and subsequent reduction with H₂ at 300°. In previous work (cf. A., 1938, I, 570) on the oxidation of CO with Be chromite as catalyst the adsorption of O₂ on the catalyst increased with each succeeding run; it is established that this effect occurs only on catalysts which had been washed. (I) had been subjected to different temp. treatments and surface determinations; the catalyst tends to become cryst. at high temp. The isotherms for the adsorption of O₂ on unwashed catalysts show reproducibility $>$ on washed catalysts. The adsorption and desorption of CO on unwashed catalysts and the catalytic efficiency from 100—400° for the oxidation of CO on amorphous, cryst., reduced, and oxidised samples of (I) (all unwashed) have been investigated at 15 and 150 mm. The adsorptions of O₂ and CO on unwashed catalysts are similar and occur in three stages: (i) instantaneous adsorption with activation energies of 3—6 kg.-cal. per mol., (ii) a slower solid solution of the adsorbed, and (iii) a much slower penetration of the dissolved, gas into the interior of the catalyst. The oxidation of CO by air also appears to take place in three stages between 100° and 300°: (i) at 150° a "loose" adsorption of CO and O₂ which has a "blocking" effect on the surface of the catalyst, the "gas phase," (ii) the "loose" adsorption is replaced by a stronger adsorption requiring higher activation energies, the "solution phase," and (iii) the tendency of the catalyst to become cryst. with increasing temp. causes chemical binding to occur, the "phase of chemical binding." W. R. A.

Composition-heat of activation diagrams. A. F. Kapustinski and B. A. Schmelev (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 617—627).—The heat of activation of the reaction $\text{H}_2\text{O} \rightarrow \text{H}_2 + \text{O}$, catalysed by alloys, varies inversely with the m.p. of the alloy in the cases Pb—Cd and Sn—Bi, in which solid solutions are not formed. The activity of Sb—Bi alloys, which are an unbroken series of solid solutions, does not vary significantly with composition. R. T.

Adsorption and nitrogen isotope exchange on metallic osmium catalysts. W. R. F. Guyer, G. G. Joris, and H. S. Taylor (*J. Chem. Physics*, 1941, 9, 287—294).—Os catalysts prepared by heating $(\text{NH}_4)_2\text{OsCl}_6$ at 573°K . show activated adsorption of H_2 and N_2 , combined with van der Waals adsorption at low temp. The adsorption of He is \gg that of N_2 . At 1 atm. pressure, the amount of N_2 adsorbed decreases with rise of temp. between 80° and 350°K , and then increases to a max. at 428°K . From the N_2 adsorption isotherm at 80°K . the area of catalyst is calc. to be 20.8 sq. m. per g., but only 4% of this area is covered at 428°K . and 1 atm. The exchange reaction $^{14}\text{N}_2 + ^{15}\text{N}_2 = 2^{14}\text{N}^{15}\text{N}$ on this catalyst is slow at 473°K . but very rapid at 573°K , with activation energy 21.8 kg.-cal. per mol. The reaction is not of second order and is inhibited appreciably by 3% of H_2 , whilst with 50% of H_2 there is no measurable reaction at 550°K . O_2 poisons the catalyst for the exchange reaction, which has activation energy 26 kg.-cal. per mol. on the poisoned catalyst. The rate of decomp. of NH_3 on the catalyst at 573°K . is 6 times that of the exchange reaction. The results favour a reaction mechanism in which the slow process involves migration of atomically bound N on a surface with few active centres. J. W. S.

Properties of promoted tungsten. A. Ravdel and F. Judin (*Compt. rend. Acad. Sci. U.R.S.S.*, 1941, 30, 37—39).—W layers containing O_2 , deposited on glass, have a sharp max. catalytic activity for C_2H_4 hydrogenation at 1 O_2 : 500 W. With further increase in O_2 content the activity decreases, vanishing at $\sim 1 \text{ O}_2$: 170 W. Pure W is inactive. Hydrogenation of C_2H_4 on the surface destroys its activity, which is not restored by heating at 180° , although the O_2 is not lost at 200° . Activated adsorption of O_2 destroys the activity, but activated adsorption of H_2 and C_2H_4 has little effect. From adsorption measurements, the true surface is calc. as 3—4 times the geometric surface for both promoted and unpromoted layers. Measurements of contact p.d. show that the work of electron emission from the layer decreases to a min., and then rises again, with increasing $[\text{O}_2]$ in the layer. L. J. J.

Promotion of [catalytic activity of] tungsten by nitrogen and hydrogen. K. Shadanovskaja, V. Korolev, and I. Motshchan (*Compt. rend. Acad. Sci. U.R.S.S.*, 1941, 30, 26—28).—The rate of hydrogenation of C_2H_4 at room temp. on W films produced by vaporisation in vac. and containing H_2 or N_2 has been measured. With increasing H_2 or N_2 content the rate increases from zero to a sharp max. and then decreases rapidly. The max. are at 1 H_2 : 200 W and 1 N_2 : 170 W, respectively. Repeated treatment of the film with $\text{H}_2 + \text{C}_2\text{H}_4$ causes a loss of activity. L. J. J.

Active surface of metallic catalysts. S. Roginski (*Compt. rend. Acad. Sci. U.R.S.S.*, 1941, 30, 23—25).—Films of Pt, Pd, Fe, Ni, and W, produced by condensation of metallic vapours in complete absence of gaseous admixtures, are inactive for catalysis of the oxidation of H_2 and the hydrogenation of C_2H_4 at low temp. Introduction of gases (e.g., N_2 , H_2 , O_2 , or org. vapours) at the moment of condensation imparts to the films a high catalytic activity which increases exponentially with the amount of gas added, up to a limiting val. Degassing destroys the activity. L. J. J.

[Catalytic] oxidation of methane under pressure.—See B., 1941, II, 173.

Catalytic polymerisation of ethylene under ordinary pressure. XI. Influence of hydrogen and nitrogen. XII. Action of acetylene.—See A., 1941, II, 181.

Catalytic dehydrogenation of cyclopentane in presence of chromic oxide. A. A. Balandin and V. S. Fedorov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1941, 30, 21—22).—The Cr_2O_3 catalyst previously described (A., 1937, I, 90) causes dehydrogenation of cyclopentane at 370 — 470° , at rates comparable with those found in the case of cyclohexane over the same

catalyst. The rate of dehydrogenation increases with rise of temp. L. J. J.

Thermal stability, poisoning, revivification, and reactivity of chromium oxide gel catalysts for dehydro-cyclisation. D. J. Salley, H. Fehrer, and H. S. Taylor (*J. Amer. Chem. Soc.*, 1941, 63, 1131—1133).—The thermal stability, poisoning, revivification, and reactivity of CrO_3 gel catalysts for the dehydro-cyclisation of $n\text{-C}_7\text{H}_{16}$ have been investigated. CrO_3 is stable up to $\sim 600^\circ$. From 470° to 525° dehydrogenation and aromatisation of C_7H_{16} are the predominant reactions, but from 525° to 560° the dehydrogenating activity decreases and from 586° to 626° cracking reactions increase. The reactivity of CrO_3 is readily revived by passing a stream of O_2 — N_2 over the spent catalyst, during which H_2O and CO_2 are evolved and a marked rise of temp. occurs. H_2O acts only as a transient poison for the dehydrogenation activity, the retardation involving a decrease in yield of PhMe and not of olefines. Transitions from the black to green forms of CrO_3 represent states of oxidation of the catalyst and not active and inactive forms. The glow phenomenon observed in H_2 or N_2 does not affect the activity of the catalyst. W. R. A.

Chromium oxide gel catalysts for dehydro-cyclisation of *n*-heptane. J. Turkevich, H. Fehrer, and H. S. Taylor (*J. Amer. Chem. Soc.*, 1941, 63, 1129—1131).—The activities at 475° of six CrO_3 gel catalysts prepared by (i) slow pptn. from dil. $\text{Cr}(\text{NO}_3)_3$ solution by dil. aq. NH_3 , (ii) formation of a jelly from $\text{Cr}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$ and NH_4OAc , (iii) pptn. as gel from $\text{Cr}(\text{OAc})_3$ with conc. aq. NH_3 , and (iv) reduction of chromic acid (a) by EtOH , (b) by sucrose, and (c) by $\text{H}_2\text{C}_2\text{O}_4$ have been examined with reference to the dehydrogenation-cyclisation activity toward $n\text{-C}_7\text{H}_{16}$ and the composition of the liquid product in olefines and aromatics. Gel (a) possessed high activity and is readily prepared; however, the diminution in activity with time in the aromatisation of $n\text{-C}_7\text{H}_{16}$ reduced the activity for the dehydrogenation of cyclohexane. Gel (b) is only moderately active. Gel (c) has high aromatising activity and is readily prepared. W. R. A.

Efficiency of the electrolytic separation of lithium isotopes. H. L. Johnston and C. A. Hutchison (*J. Chem. Physics*, 1940, 8, 869—877).—A method for analysis of the isotopic ratio of Li, involving the determination of the temp. limits between the rise and fall of LiF crystals in CHBr_3 containing traces of $n\text{-C}_5\text{H}_{11}\text{OH}$ and $\text{C}_5\text{H}_{13}\text{OH}$ as preservative, has been developed. The coeff. α of the separation of Li isotopes by electrolysis of LiCl solutions at a Hg cathode is 1.055 ± 0.005 , and within experimental error is independent of temp., fraction electrolysed, and the amount of cathodic back reaction. It is identical with abs. EtOH and H_2O as solvents. The results do not permit distinction between the mechanisms proposed for the rate-determining step, being consistent with either Bell's quantum mechanical explanation or a diffusion layer mechanism (which lead to $\alpha = 1.12$ and 1.08, respectively), if partial approach to equilibrium is assumed to occur as a secondary step. J. W. S.

Nickel and cobalt salts for electroplating baths.—See B., 1941, I, 239.

Oxidation of nitrogen in an ozoniser discharge at high temperatures. J. F. Schultz and O. R. Wulf (*J. Amer. Chem. Soc.*, 1940, 62, 2980—2987).—Relative rates of formation and decomp. of oxidised N_2 at atm. pressure, produced by the discharge of a quartz ozoniser on N_2 in air at 0 — 1000° and in N_2 — O_2 mixtures containing 50—96% N_2 at 650° , and at rates of flow (R) 100, 300, and 500 c.c. per min., have been studied. In N_2 —air the yields of oxidised N_2 increase with increasing temp., reaching a max. at $\sim 800^\circ$ and then decreasing rapidly almost to zero at 1000° . The increase is a function of R and is relatively less at higher vals. of R . In N_2 — O_2 mixtures the yields of oxidised N_2 increase with increasing $[\text{N}_2]$ and increasing R and reach a max. at $\sim 90\%$ N_2 . In N_2 —air with increasing temp. from 250° to 650° , the rate of formation is approx. the same whilst the rate of decomp. decreases rapidly, thus accounting for the increased yields at high temp. In N_2 — O_2 mixtures at 650° the rate of formation increases slowly whilst the rate of decomp. decreases rapidly with increasing $[\text{N}_2]$. The diminution in the yields from 800° to 1000° is attributed to the rate of oxidation in the ozoniser decreasing rapidly over this temp. range. For a conditioned quartz ozoniser the rate of oxidation up to

~800° varies only slightly with change in temp. or in $[N_2]$ of the mixture. The large variation in the rate of oxidation in an unconditioned ozoniser with change in temp. is attributed to changes in the dielectric surfaces comprising the ozoniser discharge. The reaction $NO_2 = NO + 0.5O_2$ is considered of primary importance in the oxidation processes.

W. R. A.

Mechanism of chemical reactions in a glow discharge. A. B. Schechter (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 493—500).—Reactions in a glow discharge take place in two steps: liberation of free atoms and radicals in the vol. of the gas, followed by adsorption on the walls of the vessel, where the reaction proceeds to completion. Ions and vibrationally excited mols. do not play a fundamental part in the processes.

R. T.

Chain carriers in Eder's reaction. G. H. Cartledge (*J. Amer. Chem. Soc.*, 1941, 63, 906—912).—The known characteristics of Eder's reaction are discussed and a chain mechanism is proposed in which the chain carriers are Hg^{\cdot} and $C_2O_4^{\cdot}$ thus: $C_2O_4 + Hg^{\cdot} \rightarrow 2CO_2 + Hg^{\cdot}$; $Hg^{\cdot} + C_2O_4 \rightarrow Hg + C_2O_4^{\cdot}$; $Hg + HgCl_2 \rightarrow Hg_2Cl_2$. $C_2O_4^{\cdot}$ is formed by the inductor. Free Hg has been detected in the Hg_2Cl_2 formed. Ti^{3+} and Cr^{2+} ions are reducing agents which induce the reaction. The normal potential of the reaction $Hg^{\cdot} \rightleftharpoons Hg^+, aq. + e$ has been calc. as -1.71 v. on the H scale and hence Hg^{\cdot} should oxidise $C_2O_4^{\cdot}$ ions more vigorously than Hg^{\cdot} . The calc. ΔG_{298}° for the dissociation of the Hg_2^{\cdot} ion is 42 kg.-cal.

W. R. A.

Photo-oxidation of iodide ion sensitised by eosin. R. Livingston and F. Hurd (*J. Physical Chem.*, 1941, 45, 547—560).—The quantum yield of the photo-oxidation of I^- sensitised by eosin increases with increase in rate of O_2 supply and with increase in $[I^-]$ and $[H^+]$, and $\propto J^{-1}$ (J = light intensity). It is independent of temp. or dye concn. A mathematical development of a suggested chain mechanism is consistent with the data.

C. R. H.

Cadmium-photosensitised reactions of propane. E. W. R. Steacie, D. J. LeRoy, and R. Potvin (*J. Chem. Physics*, 1941, 9, 306—314).—The Cd-photosensitised decomp. of C_3H_8 alone and in the presence of H_2 has been studied at 310°. The main products are H_2 and hexanes (Pr^{β} and Pr^{α}), with smaller amounts of CH_4 , C_2H_6 , C_2H_4 , and C_2H_2 . The quantum efficiency of the decomp. is ~0.6. The primary reaction is probably $Cd(^3P_1) + C_3H_8 = CdH + C_3H_7^{\cdot}$, the main secondary reactions being $H + C_3H_8 = C_3H_7^{\cdot} + H_2$ and $2C_2H_7^{\cdot} = C_2H_{10}$. As in the Hg-photosensitised reaction (A., 1940, I, 417), mainly secondary H atoms are attacked, but there is more splitting of C—C linkings, possibly owing to reactions involving CdH mols.

J. W. S.

Photolysis of ethyl iodide in various solvents. W. West and J. Fitelson (*J. Amer. Chem. Soc.*, 1940, 62, 3021—3026).—The quantum yield (ϕ) in the photolysis of EtI solutions is independent of $[EtI]$ in C_6H_{14} (0.003—0.360M.), in MeI (0.006—0.16M.), and in $EtOH$ (0.003—0.360M.). ϕ is independent of temp. between 20° and 55°, increases with decreasing λ from 3130 to 2026 Å., and depends on solvent, varying from 0.15 for CS_2 to 0.66 for Et_2O . ϕ for solutions is $> \phi$ for the gaseous state. At 2610 Å. the "normal" val. of ϕ is 0.39 and this is given in solvents which yield violet solutions of I . Solvents which give brown solutions of I give larger ϕ . Solvents which absorb the exciting radiation may still give "normal" vals. for ϕ by sensitising the decomp. of EtI . The higher vals. of ϕ in solution are explained as arising from the greater ease of recombination of I atoms relative to the combination of Et radicals and I atoms. The effect of active solvents appears to be connected with the formation of complexes of I with the solvent. An improved procedure for determining EtI in org. solvents is based on Clark's method (A., 1934, 1239).

W. R. A.

Chain photolysis of acetaldehyde in intermittent light. R. G. W. Norrish (*J. Chem. Physics*, 1941, 9, 377).—The upper val. of 16.0 kg.-cal. per mol. deduced by Haden, Meibohm, and Rice (A., 1941, I, 122) for the activation energy of the reaction $CH_3 + MeCHO = CH_4 + MeCO$, compared with the val. of 9.8 kg.-cal. per mol. found by Akeroyd and Norrish (A., 1936, 1077), indicates that a factor of $\sim 6 \times 10^{-3}$ should be introduced to allow for the necessity of orientation in the colliding mols.

J. W. S.

Photolysis of acetaldehyde and ethyl bromide mixtures at 310°. J. G. Roof and F. Daniels (*J. Amer. Chem. Soc.*, 1940, 62, 2912—2915).—By means of a special reaction cell (described) direct determination of the radiation absorbed in isothermal photochemical reactions at high temp. has been made. Photolysis of $MeCHO$ at 311° and 357° indicates a long chain in agreement with existing data. $MeCHO-EtBr$ mixtures decompose in the dark at 357° at a measurable rate and more rapidly when irradiated by 3130 Å. $EtBr$ yields Et radicals which initiate decomp. chains in $MeCHO$. The photochemical reaction appears to be due to transfer of energy from excited $MeCHO$ mols. to $EtBr$ mols. causing $EtBr$ to decompose and initiate chains in $MeCHO$.

W. R. A.

Photolysis of aliphatic aldehydes. IX. Glyoxal and acetaldehyde. F. E. Blacet and R. W. Moulton (*J. Amer. Chem. Soc.*, 1941, 63, 868—870).—Photolysis of $(CHO)_2$ by 3660 Å. yields 97% of CO and 3% of H_2 ; no unsaturated hydrocarbons were detected (cf. Norrish *et al.*, A., 1929, 37). Photolysis of vapour-phase mixtures of (i) $(CHO)_2$ and $MeCHO$ and (ii) $(CHO)_2$ and CO_2 has been carried out with mixtures of various compositions. No trace of CH_4 was found in the products from $(CHO)_2-MeCHO$ mixtures. $(CHO)_2$ does not primarily decompose into HCO radicals nor does it induce decomp. of $MeCHO$. The primary process in the photolysis of $(CHO)_2$ appears to be formation of an activated mol. which decomposes to $2CO + H_2$ or to $CO + CH_2O$.

W. R. A.

Reactions of the acetyl radical. H. W. Anderson and G. K. Rollefson (*J. Amer. Chem. Soc.*, 1941, 63, 816—821).—The photolysis of $COMe$, Ac_2 , and $AcBr$ has been carried out at temp. between 0° and 140° and the influence of temp. and added gas (NO , N_2) on the yield of CO has been investigated. The production of Ac radicals in the photolysis has been demonstrated by (i) the presence of Ac_2 among the decomp. products of $COMe$, (ii) the decrease in yield of CO on addition of NO , owing to combination occurring between Ac and NO . When Ac radicals are formed their energy of formation is so high as to cause some of them to decompose spontaneously to Me and CO but this initial surplus energy may be lost by collisions and, as a result, either decomp. or association may ensue. Both processes are shown to be of similar nature (*i.e.*, either both are homogeneous or both are heterogeneous) by the fact that addition of N_2 to Ac_2 has no effect on the yield of CO .

W. R. A.

High-temperature photolysis of acetone and the action of free methyl radicals on propane. A. O. Allen (*J. Amer. Chem. Soc.*, 1941, 63, 708—714).—The high-temp. ($> 610^\circ K.$) photolysis of $COMe$ yields $COMeEt$. The irreproducibility of CH_4 yields is interpreted as involving reaction between $COMe$ and Me on the wall of the container resulting in the production of CH_4 and CH_3COMe . The CH_3COMe is retained on the wall until it reacts with Me to give $COMeEt$. Photolysis of $COMe-C_3H_8$ mixtures yields no unsaturated hydrocarbons, indicating that Pr^{α} and Pr^{β} radicals are stable at 610° K. The Pr radicals disappear by reaction with Me or Ac radicals to give the appropriate C_4H_{10} . From the ratio of n - to iso - C_4H_{10} it is concluded that the difference in activation energy for the removal of H from primary and *sec.* C is 2060 g.-cal.

W. R. A.

Photolysis of diacetyl in the near ultra-violet. J. G. Roof and F. E. Blacet (*J. Amer. Chem. Soc.*, 1941, 63, 1126—1128).—The quantum yield (Φ), calc. on the basis of the no. of mols. of CO formed per $h\nu$ absorbed, (i) increases with temp., (ii) at const. temp., increases with decreasing λ , and (iii) decreases with increase in absorbed intensity at 2654 and 3660 Å. The gaseous products are CO , CH_4 , C_2H_6 , and traces of H_2 and unsaturated compounds. The $CH_4:C_2H_6$ ratio is $\sim 3:1$. The $CH_4:CO$ ratio increases rapidly with temp. and decreases slightly with increased light intensity. The chain mechanism proposed by Rice and Walters (A., 1940, I, 77) for the thermal decomp. of Ac_2 is extended to account for the appreciable amounts of C_2H_6 formed, especially at low temp. C_2H_6 is most likely formed by (i) $Me + MeCO \rightarrow C_2H_6 + CO$ or (ii) $2Me \rightarrow C_2H_6$, with (i) functioning only at $< 100^\circ$.

W. R. A.

Photochemical bromination of aryl methyl ketones. J. R. Sampey and E. M. Hicks (*J. Amer. Chem. Soc.*, 1941, 63, 1098—1101).—The photochemical bromination of $COPhMe$ and its *p*-Cl-, *p*-Br-, β - $C_{10}H_7$, *o*-OH- (I), and *o*-OMe-deriv-

atives has been investigated under a variety of conditions at 30°. H₂O is a negative catalyst for all except (I); S also exerts, although to a smaller extent, negative catalysis. Increase in intensity of irradiation and [HCl] shorten the time of bromination in CCl₄. Acid increases the rate of formation of the additive compound (II) of Br and ketone. The time required for separation of (II) is shortened by irradiation. After separation of (II) bromination proceeds rapidly, but until (II) separates no bromination occurs. Irradiation does not appreciably affect the rate of decomp. of (II), whilst H₂O prolongs the time of formation and the period of decomp. of (II). W. R. A.

IX.—METHODS OF PREPARATION.

Rules for naming inorganic compounds. W. P. Jorissen, H. Bassett, A. Damiens, F. Fichter, and H. Rémy (*J. Amer. Chem. Soc.*, 1941, **63**, 889—897).—Report of the Committee of the International Union of Chemistry for the Reform of Inorganic Chemical Nomenclature, 1940. W. R. A.

Generalised rule for chemical and electrochemical reactions. V. A. Kistiakovski (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, **29**, 454—459).—If *L* is the min. no. of "elementides," i.e., elements, or groups which remain intact during a chemical or electrochemical reaction, and *M* is the no. of mol. species ("molides") in reactants and products, $M = L + I + n$. In most chemical and nearly all electrochemical reactions $n = 0$; if restrictions defining the mode of interaction of reactants are necessary, n is > 0 , but if the equation can be balanced without reference to one or more of the elementides, n is < 0 . Examples of the use of the rule are given. A. J. E. W.

Spectroscopic study of intermediate products of oxidation of H₂, CO, and CS₂. V. Kondratyev (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 501—509).—Spectroscopic study of the H₂ flame shows the presence of OH, O, and H₂O₂, which are supposed to be intermediate stages in the process of oxidation of H₂. OH is also an intermediate of oxidation of moist CO. S₂, CS, SO, and COS were detected in the CS₂ flame, and are considered to be intermediates. R. T.

Electron diffraction study of the corrosion of metals. Corrosion of sodium, calcium, and magnesium in aqueous chloride and alkaline solutions. S. Yamaguchi (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, **20**, 204—209; cf. A., 1940, I, 410).—The electron diffraction patterns of films formed on Na, Ca, and Mg by reaction with H₂O and aq. NaCl (~5%) have been investigated. On Ca and Mg the films formed in the presence of Cl⁻ ion are more strongly oriented and the crystal size is larger than in films formed by H₂O and air. No difference was observed between the films formed on Na by H₂O and air, and those formed by aq. NaCl. Crystals are oriented in both cases. O. D. S.

Carbonate conditioning of boiler water.—See B., 1941, I, 194.

Reactions in the solid state between calcium oxide and different preparations of titanium dioxide. J. A. Hedvall and K. Andersson (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, **20**, 210—217).—The reaction in air at 900—1200° of CaO with TiO₂ in the following forms: anatase (I), rutile (II) (Fe₂O₃ 8.5%), a pure anatase modification (III) prepared by heating TiO₂ at 1000° for 2.5 hr., and a pure rutile modification (IV) prepared by heating TiO₂ at 600° for 2.5 hr., has been investigated. Reactivity of TiO₂ increases in the order (III) < (I) < (IV) < (II). The high reactivity of (II) and (IV) is ascribed to the unstable crystal structure and that of (II) to the high Fe₂O₃ content. The product of reaction was identified by its composition and X-ray diagram as CaTiO₃. No difference in the reaction rate was observed when N₂ or H₂ was substituted for air. O. D. S.

X-Ray examination of vanadium nitride. I. Process of thermal decomposition of ammonium vanadate and formation of vanadium nitride. V. Epelbaum and A. Brager (*Acta Physicochim. U.R.S.S.*, 1940, **13**, 595—599).—Powder photographs and chemical analyses show that the decomp. of NH₄VO₃ in a stream of NH₃ goes through the following stages: NH₄VO₃ → V₂O₅ (125—300°); V₂O₅ → VO₂ (~400°); VO₂ → V₂O₃ (600—700°); V₂O₃ → VO (900°). Simultaneously, formation of VN begins at ~400°, and pure VN is obtained at 1000—1100°. F. J. G.

Structure of mercurous chloride vapour. P. W. Selwood and R. Preckel (*J. Amer. Chem. Soc.*, 1940, **62**, 3055—3056).—Between 250° and 375° the vapour is diamagnetic and therefore its structure is neither HgCl nor Hg₂Cl₂ but a mixture of Hg and HgCl₂. W. R. A.

Reaction of anhydrous rare earth bromides with ethyl benzoate and the separation of neodymium from lanthanum. R. C. Young, A. Arch, and W. V. Shyne, jun. (*J. Amer. Chem. Soc.*, 1941, **63**, 957—958).—LaBr₃, NdBr₃, PrBr₃, and SmBr₃ react with EtOBz thus: MBr₃ + 3EtOBz = M(OBz)₃ + 3EtBr. The reactions occur at relatively low temp. but the rates vary considerably for the different bromides. The benzoates are insol. in H₂O. NaBr₃ reacts so much more rapidly than LaBr₃ that separation of Nd and La can thereby be effected. W. R. A.

Thermal transformations of thallous formate. L. C. Freidlin, A. A. Balandin, and A. I. Lebedeva (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 955—962).—The reactions (i) 2HCO₂Tl (I) → Tl₂CO₃ + CO + H₂, (ii) 2(I) → 2Tl + 2CO₂ + H₂, (iii) 2(I) → 2Tl + CO₂ + HCO₂H take place at 210—270°; reactions (ii) and (iii) are favoured by rising temp. and by dehydrogenation catalysts (Pt-black, Os-asbestos). Oxalate is not produced under any conditions. (I) reacts with NaNH₂ at 97° or CaO at 130—230° as follows: 2(I) + 2NaNH₂ → NaHCN₂ + NaOH + Tl₂CO₃ + H₂; 2(I) + CaO → CaCO₃ + 2Tl + H₂, whilst with Ac₂O at 50° the reaction is Ac₂O + (I) → TlOAc + AcOH + CO. R. T.

Exchange of sulphate ion with water. J. L. Hyde (*J. Amer. Chem. Soc.*, 1941, **63**, 873—874).—Exchange in acid, alkaline, and neutral solution has been investigated and results are compared with existing data. The mechanism is believed to be similar to that of the CO₃²⁻ exchange (Mills and Urey, A., 1940, I, 325). W. R. A.

Malonatomanganates. G. H. Cartledge and P. M. Nichols (*J. Amer. Chem. Soc.*, 1940, **62**, 3057—3060).—*K* dimalonatodiquomanganate, K[Mn(C₂H₃O₄)₂(H₂O)₂], has been prepared from KMnO₄ and malonic acid in abs. MeOH in hydrated (I) and anhyd. forms. It yields with syrupy phosphoric acid a violet complex, with KCN the hexacyano-complex, with HF the pink pentafluoro-aquo-complex, and with pyrocatechol, cupferron, and salicylic acid other complexes. Spectrophotometric analysis of solutions of (I) in malonate buffers indicates the equilibrium [Mn(C₂H₃O₄)₂]³⁻ + 2H₂O ⇌ [Mn(C₂H₃O₄)₂(H₂O)₂]³⁻ + C₂H₃O₄²⁻, for which the const. at 0° is 0.057, corresponding with ΔG₂₇₃⁰ = 1550 g.-cal. From preliminary measurements of electrode potentials the dioxalato-diaquo-complex is more stable than the dimalonato-complex by ~1000 g.-cal. per mol. W. R. A.

Isothermal dehydration of heavy-metal iron cyanides. H. B. Weiser, W. O. Milligan, and J. B. Bates (*J. Physical Chem.*, 1941, **45**, 701—706).—The continuous dehydration isotherms of gels of Cu₂Fe(CN)₆, Cu₃[Fe(CN)₆]₂, Fe₄[Fe(CN)₆]₃, and Fe₃[Fe(CN)₆]₂ afford no evidence for hydrate formation. Electron diffraction patterns for Cu₂Fe(CN)₆ obtained in a high vac. are identical with X-ray diffraction patterns of the moist gel, this being further evidence that this gel is not a hydrate. C. R. H.

Heating curve method of study of thermal stability and transformations of certain complex compounds of platinum. A. V. Nikolaev and A. M. Rubinshtein (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 787—794).—The heating curves of salts of [Pt(NH₃)₅Cl]³⁺ are characteristic of the given anion; the stability of the salts rises with increasing diameter of the anion, in the order Cl⁻ < NO₃⁻ < SO₄²⁻. At 170—195° [Pt(NH₃)₅Cl]Cl₃ yields a mixture of [Pt(NH₃)₄Cl₂]Cl₂ (70%) and [Pt(NH₃)₄NH₂Cl]Cl₂ (30%); a double salt of these two salts is also obtained. R. T.

Co-ordination theory and co-ordination compounds of the platinum group metals. R. N. Keller (*J. Chem. Educ.*, 1941, **18**, 134—142).—A review. L. S. T.

Co-ordination compounds with furfuraldoxime as a chelate group.—See A., 1941, II, 199.

X.—ANALYSIS.

Indicator properties of 8-hydroxyquinoline-5-sulphonic acid and its derivatives. H. B. Feldman and A. L. Powell (*J. Amer. Chem. Soc.*, 1940, **62**, 3107—3109).—The dissociation

curves and acid and basic dissociation consts. of 8-hydroxy-quinoline-5-sulphonic acid and its 7-Cl- (I), -Br- (II), and -I- (III) and 6-Me derivatives have been determined over the p_H range 0—10. All functioned as amphoteric indicators and formed yellow coloured solutions at the point of max. colour intensity, the intensity decreasing as the p_H varied from that corresponding with the isoelectric point. The colours of (I), (II), and (III) were of equal intensity but much deeper than those of the other two compounds at the same degree of dissociation. (I) is the most easily accessible and hence the most practical for use as an indicator. The p_H of max. colour intensity of (III) is given as 4.5 (cf. A., 1929, 666). W. R. A.

Deviation of the $\Delta E-\Delta p_H$ curve from the rectilinear, using a glass electrode with a ballistic potentiometer. G. V. Zotov (*J. Appl. Chem. Russ.*, 1940, 13, 1531—1534).— p_H may be determined with an error ± 0.02 , using a glass electrode and a ballistic potentiometer. R. T.

Determination of p_H in wood.—See B., 1941, I, 232.

Reaction of hypochlorites with nitrites. N. M. Vaksberg (*J. Appl. Chem. Russ.*, 1940, 13, 1504—1511).—Oxidation of NO_2^- by Cl liberated from OCl^- is not instantaneous except at $p_H < 6$, above which the velocity of reaction $\propto [H^+]$. This should be taken into consideration in H_2O analysis, and in calculation of the amount of $NaOCl$ required for chlorinating drinking H_2O . R. T.

Determination of a small quantity of chlorine by iodometry. S. Hirano (*J. Soc. Chem. Ind. Japan*, 1941, 44, 30—32b).—The sample, containing < 1 mg. of Cl, is digested with CrO_2 and H_2SO_4 at $\sim 150^\circ$ and the gases evolved are passed in a stream of air through a vessel heated at 110° to oxidise HCl and then through a tube filled with SiO_2 fragments to decompose Cl oxides into Cl_2 . The Cl_2 is then absorbed in aq. KI and the I liberated is titrated with standard $Na_2S_2O_3$. The digestion reagent is prepared by heating CrO_2 (120 g.), $CuSO_4$, SeO_2 , or $Ag_2Cr_2O_7$ (5 g.), and conc. H_2SO_4 (1 l.) at 150° for 40 min. with a stream of air passing through the vessel to remove any Cl present in the reagents. The method is inapplicable for determination of Cl in presence of Br. In presence of I the digestion reagent containing $Ag_2Cr_2O_7$ is used. As_2O_3 in the sample does not affect the results. J. W. S.

Determination of chlorine in solid fuels.—See B., 1941, I, 209.

Inner adsorption in salt crystal systems. VII. Upper limit of the amount of the inner adsorbed salt. D. Balarew (*Z. anal. Chem.*, 1940, 118, 411—415).—Data for the pptn. of $BaSO_4$ in presence of K^+ , Fe^{+++} , NH_4^+ , or Cs^+ show that contamination by inner adsorption can reach 37 mol.-%. Diminution of the contamination occurs by an ageing process, which takes place when mother-liquor and ppt. are left in contact. Contamination is not due to mixed crystal formation. L. S. T.

Determination of total sulphur in solid fuels by the gasification process.—See B., 1941, I, 208.

Analytical chemistry of nitrogen compounds. I. Detection of nitrous acid in alkaline solution. K. Suzuki (*J. Soc. Chem. Ind. Japan*, 1940, 43, 404b).—The NO_2^- is reduced with excess of Na_2CO_3 , glucose, and $FeSO_4$. Reducing agents such as $SnCl_2$, $TiCl_3$, or $H_2C_2O_4$ are unsatisfactory. D. F. R.

Argentometric titration of cyanide ion with diphenylcarbazone as indicator. R. Ripan-Tilici (*Z. anal. Chem.*, 1940, 118, 305—307).—In the titration of 0.01—0.05M-KCN with 0.1—0.05M- $AgNO_3$ in alkaline solution (p_H 9—10), diphenylcarbazone (0.3% in EtOH) acts as a colour indicator (violet) when the ratio $Ag^+ : CN^-$ is 1 : 2, and as an adsorption indicator (blue colour of the ppt.) when this ratio is 1 : 1. 4—5 drops are added at the start of the titration, and then 1—2 more near the end. Test data are recorded. L. S. T.

Determination and separation of potassium as periodate. H. H. Willard and A. J. Boyle (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 137—139).—K is pptd. as KIO_4 by adding HIO_4 to 3—4 ml. of the nitrate solution. Pptn. is completed by adding a mixture of equal vols. of aldehyde-free EtOH and anhyd. EtOAc, cooling to 0° , and stirring mechanically for 30 min. The KIO_4 can be weighed after drying at 105° , or dissolved in H_3BO_3 -borax buffer, and the I liberated after

addition of KI, titrated with 0.1N- Na_2AsO_3 . K can be separated from Ca, Mg, Zn, Al, Na (70 times the amount of K), Li, Ni, and Co, but not from Mn, Fe, Cr, Rb, Cs, or NH_4^+ . When Ca^{++} and SO_4^{--} are both present the results are low, probably owing to the formation of $CaSO_4 \cdot K_2SO_4$. Small amounts of H_2SO_4 , H_3PO_4 , HNO_3 , and H_2BO_3 can be present. Cl^- must be absent. In presence of SO_4^{--} , only the volumetric method can be used. It can be applied to the mixed chlorides obtained by the Lawrence Smith method, after conversion of chlorides into nitrates by evaporation with conc. HNO_3 . The method is rapid, and accurate for ≤ 4 mg. of K. Details of procedure and test data are given. L. S. T.

Analysis of sodium hyposulphite.—See B., 1941, I, 222.

Determination of free alkali in soaps.—See B., 1941, II, 194.

Radiometric titration with radioactive phosphorus as end-point indicator. A. Langer (*J. Physical Chem.*, 1941, 45, 639—643).—Radioactive P, obtained by deutron bombardment of red P, is oxidised to H_3PO_4 and several drops are added to a solution of Na_2HPO_4 so that 1 ml. of reagent added to 50 ml. of H_2O gives a few hundred counts per min. Mg, Ag, Ba, Pb, Th, and UO_2^{++} can be determined by titrating with the PO_4^{--} reagent, the radioactivity being measured with a Geiger-Müller counter. PO_4^{--} can be titrated by adding a drop of the reagent (this does not appreciably alter the PO_4^{--} concn.) and titrating with $MgCl_2$ in presence of aq. NH_3 and NH_4Cl . Titrations with $(NH_4)_2MoO_4$ are inconvenient mainly because of the slow formation of the ppt. C. R. H.

Rapid colorimetric determination of magnesium [in boiler waters] by means of Titan-yellow.—See B., 1941, I, 195.

Determination of cadmium. T. L. Thompson (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 164—165).—Cd is pptd. from a mixture of $Cd^{++} + Zn^{++}$ by means of a brucine sulphate-KI mixture, the ppt. washed with a solution of the precipitants, followed by EtOH + PhMe (1 : 4), dissolved in H_2O , and the iodide titrated with $AgNO_3$ (eosin-Y as adsorption indicator). Fe, Cu, Pb, Sb, and oxidising acids must be absent. The method is applicable to all ratios of Cd to Zn. Procedure for determining Cd in a sulphide ore is detailed. L. S. T.

Detection of cadmium in presence of copper. A. C. Holler (*J. Amer. Chem. Soc.*, 1941, 63, 873).—Cd can be detected in presence of Cu, even in the Cu : Cd ratio of 10 : 1, by the following procedure. After removal of Pb and of Bi as $Bi(OH)_3$ the ammoniacal solution containing Cu and Cd is neutralised with HNO_3 , 5 ml. of conc. HNO_3 are added, and the solution is evaporated to dryness. After removal of NH_4 salts the residue is dissolved in 1.5 ml. of dil. HNO_3 and made up to 25 ml. with H_2O . 12 ml. of 0.5N-NaOH are added and the pptd. $Cu(OH)_2$ and $Cd(OH)_2$ are collected and washed once with H_2O . On spotting with 1% phenolphthalein in EtOH and moistening with H_2O , $Cd(OH)_2$ gives crimson colour but $Cu(OH)_2$ gives no coloration. W. R. A.

Sensitivities of the detection of lead and sulphide ions as lead sulphobromide. Z. Karaoglanov (*Z. anal. Chem.*, 1940, 118, 311—322).—The intense colour of $(PbBr)_2S$ (I) is used to detect Pb^{++} . Data on the sensitivity of the test carried out in different ways are recorded. In test-tube reactions sensitivity depends on $[HBr]$ and $[H_2S]$, and varies between 59.2 and 529 $\mu g.$ Pb^{++} per 10 c.c. The stability of (I) formed in presence of OAc^- is less than that formed in presence of NO_3^- . $(PbCl)_2S$ is much less stable than (I), and is useless as a test for Pb^{++} . Pb^{++} is best detected by adding HBr to the sample, evaporating to dryness in porcelain, and moistening the residue with 1—3 drops of x-HBr and 1—2 of aq. H_2S . Red or yellow flecks show the presence of ≤ 8 —12 $\mu g.$ of Pb. $PbCl_2$, $PbSO_4$ (≤ 0.1 mg.), and galena (≤ 0.1 mg.) (II) also give the test under these conditions. On filter-paper, the sensitivity is 3—9 $\mu g.$, but the test is then not applicable to $PbSO_4$ or (II). In presence of Ag^+ , the sensitivity is 29—59 $\mu g.$ of Pb^{++} . Cu^{++} , Bi^{+++} , Cd^{++} and Sb^{+++} , but not Zn^{++} , Al^{+++} , Ba^{++} , and Sr^{++} , interfere, and Sn^{++} must first be oxidised (aq. Br) to Sn^{+++} . The formation of (I) can be used as a test for S^{--} , and sensitivity varies from 2.4 to 7.2 $\mu g.$ according to the method employed. L. S. T.

Chemical analysis of clays.—See B., 1941, I, 226.

Electrolytic determination of indium. S. Yatagawa (*J. Soc. Chem. Ind. Japan*, 1940, 44, 68B).—After conversion into the sulphate the solution is buffered with $\text{Na}_2\text{B}_4\text{O}_7$, HCO_2Na , and HCO_2H , and electrolysed for 6 hr. at room temp., with 0.2–0.25 amp., using a Cu-plated Pt cathode and a spiral Pt anode. With 0.1–0.05 g. of In the error is $\pm 0.2\%$.

D. F. R.

Gravimetric determination of permanganate. G. V. Medox and A. V. Krilov (*J. Appl. Chem. Russ.*, 1940, 13, 1529–1530).—Excess of aq. PPh_3Br is added to a vol. of solution containing ~ 0.1 g. of KMnO_4 , and the ppt. of $\text{PPh}_3\cdot\text{MnO}_4$ is collected after 12 hr., washed, dried, and weighed. Chromates do not interfere.

R. T.

Determination of iron. S. Baba (*J. Agric. Chem. Soc. Japan*, 1941, 17, 139–143).— Fe^{+++} is determined colorimetrically by means of $\text{K}_3\text{Fe}(\text{CN})_6$. The colorimetric gives lower results than the gravimetric method, the difference being 8.4%. $(\text{NH}_4)_2\text{SO}_4$ and Fe^{++} interfere, and the latter must be previously oxidised to Fe^{+++} .

J. N. A.

Amperometric titrations. V. Titration of cobalt with α -nitroso- β -naphthol. I. M. Kolthoff and A. Langer (*J. Amer. Chem. Soc.*, 1940, 62, 3172–3175; cf. A., 1940, I, 131).—Cu, Co, and Pd have been titrated amperometrically with 1:2- $\text{NO}\cdot\text{C}_{10}\text{H}_7\text{OH}$ (R) at the dropping Hg electrode at room temp. in AcOH-acetate (I) and $\text{NH}_3\text{--NH}_4\text{Cl}$ (II) buffers. Cu can be titrated in (I) or (II), the ppt. at the end-point having the composition CuR_2 . Pd^{II} can be titrated in (I) and the ppt. is of the composition PdR_2 . Co is best titrated in (I) in the absence of air at a potential of -0.6 v. of the dropping Hg electrode. From 1 to 20 mg. have been determined with an accuracy of at least 0.5%. The Co:R in the ppt. at the end-point is 1:4, the composition of the ppt. being probably $\text{CoR}_2\cdot 2\text{HR}$. In the acid medium no indication of Co^{III} in the ppt. is observed. Titrations of Co in (II) gave variable results, probably owing to air oxidation. The approx. composition of the ppt. at the end-point corresponds with CoR_2 . Titration of a neutral Co solution in dil. KCl with an aq. solution of KR yields a ppt. of CoR_2 . The extension of the method to titration of the ions of U, Zr, Cr, Fe, Sn, Ti, V, and W is suggested.

W. R. A.

Determination of nickel and cobalt in meteoric iron. E. P. Henderson (*Amer. J. Sci.*, 1941, 239, 372–378).—The wide variations in composition shown by different analyses of the same Fe meteorite may be due to methods of sampling, and to methods of separating Ni and Co from Fe. Fe should always be determined volumetrically, and Ni by pptn. with dimethylglyoxime in presence of tartaric acid. Ni can be separated from Fe by four pptns. of the Fe made by pouring the solution of the meteorite into hot, dil. (1:2) aq. NH_3 . Co is not separated satisfactorily by this method, 9–17% of the total Co being retained by the Fe. Data for various meteorites are recorded.

L. S. T.

Volumetric determination of nickel ions with potassium cyanide, and diphenylcarbazone as colour indicator. R. Ripan-Tilici (*Z. anal. Chem.*, 1940, 118, 308–310).—The freshly-prepared 0.05–0.01M KCN is titrated with a neutral solution of the Ni^{II} in presence of 4–5 drops of 0.3% alcoholic diphenylcarbazone solution. Ni^{II} in excess of the ratio 1 Ni^{II} :4 CN^- is shown by a sudden, intense, red coloration. Rapid titration to avoid carbonation of the KCN is recommended. CN^- can be determined by titration by aq. NiSO_4 (not chloride or nitrate). Test data are recorded.

L. S. T.

Potentiometric analysis of the metals of the ammonium sulphide group. H. Steuer (*Z. anal. Chem.*, 1940, 118, 385–398).—The following potentiometric titrations are described and their relative merits discussed: using a Pt indicator electrode and a AgI comparison electrode, Cr^{VI} with FeSO_4 , SnCl_2 , or TiCl_3 , Cr^{III} with $\text{K}_3\text{Fe}(\text{CN})_6$ in strongly alkaline solution with Ti salt as catalyst, Al^{III} with 0.1N-NaF, Ti^{IV} with 0.1N- $\text{K}_2\text{Cr}_2\text{O}_7$, U^{VI} with TiCl_3 , and U^{IV} with $\text{K}_2\text{Cr}_2\text{O}_7$, after reduction from U^{VI} by means of Zn and HCl, Fe^{III} with SnCl_2 , or TiCl_3 , Fe^{II} with $\text{K}_2\text{Cr}_2\text{O}_7$, after reduction of Fe^{III} by Zn and HCl; using a Ag_2S indicator electrode and a Ag comparison electrode, MnO_4^- with $\text{H}_2\text{C}_2\text{O}_4$, Mn^{II} with 0.1N- $\text{K}_3\text{Fe}(\text{CN})_6$, or with KMnO_4 by conversion into Mn^{III} in presence of F^- , Co^{II} with KCN, or $\text{K}_3\text{Fe}(\text{CN})_6$ permitting the determination of Co in presence of Ni, Ni^{II} with KCN, and Zn^{II} with 0.1N- Na_2S . Interfering metals are pointed out, and data for some of these methods and their applications to

mixtures of Cr, Al, Fe, U, and Ti, and of Mn, Co, Ni, and Zn are recorded. Titration with $\text{K}_3\text{Fe}(\text{CN})_6$ is the most serviceable method for Cr, and U, Al, Fe, Mn, Bi, Cu, As, Sb, Hg, and V do not interfere, and titration with KMnO_4 in presence of F^- is the best for Mn.

L. S. T.

Precipitation of tin by means of phenylarsinic acid. V. I. Kuznetsov (*J. Appl. Chem. Russ.*, 1940, 13, 1512–1516).— PhAsO_2H_2 (I) is not a suitable reagent for pptn. of Sn from solutions of SnCl_4 , as pptn. is incomplete except in presence of large excess of (I), and the ppt. may be contaminated with other elements (Th, Sb). Pptn. is quant. from solutions of $\text{Sn}_2\text{O}_3\cdot\text{Cl}_2(\text{OH})_2$ (II) containing HCl 4–10, (I) 0.1–1, and Sn^{IV} $< 0.01\%$; with more dil. solutions the $[\text{HCl}]$ should be $> 4\%$. Complex-forming substances interfere less in the case of (II) than of SnCl_4 .

R. T.

Valuation of monazite sands.—See B., 1941, 1, 223.

Fractional micro-chemical reaction for palladium. I. M. Korenman (*J. Appl. Chem. Russ.*, 1940, 13, 1523–1524).—A drop of solution is evaporated to dryness on a slide, and a drop of saturated solution of dimethylglyoxime in 2.5% AcOH in 50% EtOH is added, when yellow needles appear in presence of ≤ 5 p.p.m. of Pd^{II} . Au^{III} interferes when in considerable excess; other cations do not interfere.

R. T.

Determination of metals of the platinum group in nickel ores and concentrates.—See B., 1941, I, 239.

XI.—APPARATUS ETC.

Laboratory high-vacuum furnace. W. F. Ehret and D. H. Gurinsky (*Rev. Sci. Instr.*, 1941, 12, 151–153).—With the C tube furnace described a vac. of 10^{-3} to 10^{-5} mm. is maintained at temp. of 700–1600°; 25-g. melts at 1550° take 6 min. and are practically free from gas and C. A. A. E.

Discoloration of quartz windows of an ultra-violet source. R. J. Dwyer and H. W. Leighton (*Rev. Sci. Instr.*, 1941, 12, 156–157).—Purplish discoloration, particularly near the edge of the exposed portion, could not be removed by washing, treatment with HF, or grinding. The effect is attributed to reflexion of ultra-violet light in the Schumann region from the walls of the discharge tube, and not to electron bombardment.

A. A. E.

Absorption spectrographic methods. H. von Halban and M. Litmanowitsch (*Helv. Chim. Acta*, 1941, 24, 44–50).—Improvements in technique are suggested as a result of experience with the method previously described (cf. A., 1936, 1223). In connexion with one of the improvements (the use of chromate instead of picrate solutions for calibrations at low $\lambda\lambda$) the absorption of such solutions over the range 208–444 m μ . has been determined.

C. R. H.

Precision direct-reading spectrophotometer. A. L. Narayan and C. K. Ananthasubrahmanyam (*Indian J. Physics*, 1940, 14, 393–399).—In the instrument described a double monochromator is used to permit only a small region of $\lambda\lambda$ to enter the Littrow prism spectrograph, and the intensity of the lines is determined by means of a photo-cell, the current from which is amplified and read directly on a galvanometer. The photo-cell and amplifier are mounted in an evacuated cast-Fe cylinder which acts also as an electrical screen. Tests have been made by measuring the intensities of the 4078 and 4047 Å. lines from a Hg arc and the energy distribution in the H_β line of the solar spectrum. The instrument is highly sensitive, easily adjusted, and rapid in use and is designed for precise and complete analysis of absorption and fluorescence spectra.

J. W. S.

Application of the grating micro-spectrograph to the problem of identifying organic compounds. E. E. Jelley (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 196–203).—A reflexion-grating micro-spectrograph for the study of crystal optics is described. Methods of measuring the birefringence of crystals are given, and illustrated by photographs of the birefringence spectrograms of 1- $\text{C}_{10}\text{H}_7\cdot\text{NO}_2$, piperonal, $p\text{-NO}_2\cdot\text{C}_6\text{H}_4\cdot\text{OH}$, and benzil. Investigation of coloured crystals shows that the spectral absorptions of a crystal depend on chemical composition and on crystallographic structure, and a classification of six factors affecting colour is presented and discussed.

L. S. T.

Colour, its measurement, discrimination, and specification.—See B., 1941, II, 186.

Beryllium windows for X-ray tubes. H. P. Klug (*Rev. Sci. Instr.*, 1941, 12, 155—156).—By tool grinding or, preferably, hand grinding with abrasive cloth tape, Be plates 0.5 in. square were reduced in thickness from 0.0625 in. to 0.008 in. Such plates are more transparent than Al foil 0.001 in. thick, particularly for the longer $\lambda\lambda$. A. A. E.

Theory of glass electrode. V. Influence of negative ions. M. Dole, R. M. Roberts, and C. E. Holley, jun. (*J. Amer. Chem. Soc.*, 1941, 63, 725—730; cf. A., 1935, 170).—The influence of F^- , Cl^- , $B_4O_7^{2-}$, OAc^- , and OH^- ions on the alkaline errors of the glass electrode with K^+ as positive ion, over the pH range 4—14, has been studied. No negative ions appear to affect the alkaline errors of the electrode but the errors increase in the high- pH range if the electrode is initially exposed to $\sim 1N$ -fluoride solutions of $pH < 7$ due to the glass being attacked by HF . Measurements with a new type of Na error-free glass electrode and NET_4Br indicate its superiority over the ordinary type of glass electrode at $pH > 7$. W. R. A.

Measurement of flow properties with the Gardner viscometer. P. W. Kinney (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 178—185).—A method for obtaining results in abs. units is described. For true liquids, the range of application, using 3 different discs, is 10^{-1} to 10^4 poises, and a precision of $\sim 2\%$ can be obtained. Data for mixtures of kaolin and Manila copal resin are reproduced and discussed. L. S. T.

Instrument for rheological studies of plastic substances. C. R. Bailey (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 173—177).—Details of construction, accessories, and procedure of a new instrument are discussed, especially in relation to the study of lyogels. L. S. T.

Dust-sampling methods.—See B., 1941, I, 239.

Electric heating mortar for use in carbon and hydrogen micro-combustions. G. F. Smith and W. H. Taylor (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 203—204).—Details of construction of an electrically-heated mortar, thermostatically controlled, and providing a temp. control of $1-2^\circ$ over the range $150-220^\circ$, are given. L. S. T.

Volumetric flasks for micro-analysis. E. R. Caley (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 204).—The upper part of the flask is spherical and has a capacity ~ 5 times that of the lower calibrated conical part. Trapping of liquid in the stopper is eliminated, and mixing facilitated. L. S. T.

Silica and Pyrex glass stills with automatic constant-pressure feeds. C. S. Piper and A. C. Oertel (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 191—192).—Three types of still for redistillation of H_2O are described and illustrated. The yield is $1-2$ l. per hr., and operation is continuous. A Mariotte's bottle maintains a const. level of H_2O in the still. The re-distilled H_2O contains $>0.2-0.3 \mu g.$ of Cu per l. L. S. T.

Vacuum packing for valves. L. N. Ridenour and G. P. Harnwell (*Rev. Sci. Instr.*, 1941, 12, 157).—A device for making the packing of a standard hand-operated valve vacuum-tight is modelled on Wilson's sliding seal (A., 1941, I, 224). A. A. E.

Modern high-pressure laboratory apparatus. B. A. Korn-dorf (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 997—1015).—A review. R. T.

Determination of the mechanical equivalent of heat. A. G. Chowdri and D. S. Kothari (*Indian J. Physics*, 1940, 14, 409—413).—A variation of Laby and Hercus' method, in which the rotating magnetic field is replaced by a linear oscillatory field, is described. J. W. S.

XIII.—GEOCHEMISTRY.

Chemical composition of a lithia spring near McLeod, Montana. H. Sobotka and M. Reiner (*Amer. J. Sci.*, 1941, 239, 383—385).—The spring H_2O contains $Li^+ 0.81$, $K^+ 1.2$, $Na^+ 11.7$, $Mg^{++} 18.7$, $Ca^{++} 64.3$, $Cl^- 0.86$, $SO_4^{--} 112.4$, and total solids 328 mg. per l. It issues warm from the Mesozoic strata at the northern boundary of the Absaroka Forest near McLeod. Li contents of springs from other parts of the world are tabulated. L. S. T.

Winter oxygen régime of Mologa river. A. P. Schtscherbakov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1941, 30, 43—46).— O_2 deficiency in the Mologa river during the winters of 1939 and 1940 was traced to contamination of a tributary with

oxidisable industrial effluent and to low initial O_2 content of the Mologa waters. Aération by weirs is suggested to avoid O_2 deficiency and resultant fish mortality in reservoirs fed by the river. L. J. J.

Physical properties of massive topaz.—See B., 1941, I, 226.

Ural ferriiferous chlorites. E. J. Rode and T. V. Rode (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 943—954).—Heating curves are recorded and interpreted for a no. of chlorites, for which analytical data are also given. Endothermic effects are ascribed to dehydration processes, with small exothermic effects due to oxidation of Fe^{II} . R. T.

Southern California ring-dike. R. Merriam (*Amer. J. Sci.*, 1941, 239, 365—371).—The rocks of a portion of the Peninsular Range batholith of southern California have a concentric distribution and structure. Indirect evidence suggests (i) intrusion of a boss of melanocratic tonalite into a domical structure of schists and older intrusives, (ii) irregular tonalite intrusions around the boss, and (iii) subsidence of the boss and intrusion of a leucocratic tonalite ring into the resulting space. L. S. T.

Thermodynamic properties of gypsum and its dehydration products. K. K. Kelley, J. C. Southard, and C. T. Anderson (*U.S. Bur. Mines, Tech. Paper* 625, 1941, 73 pp.).—In the $CaSO_4 \cdot H_2O$ system the following substances having unique and reproducible thermodynamic properties were investigated: $CaSO_4 \cdot 2H_2O$ (I), $CaSO_4 \cdot 0.5H_2O$ (IIa and IIb), $CaSO_4$ (IIIa, IIIb, and IV). (IIa) is stable and (IIb) metastable with reference to one another. (IIa) is prepared from (I) in presence of liquid H_2O above 97° or in saturated steam; it loses H_2O with formation of $CaSO_4$ (sol.) in one step, and is non-zeolitic. (IIb) is prepared from (I) by dissociation in vac. or in a nearly dry atm. followed by annealing at $\sim 100^\circ$; it loses H_2O with formation of $CaSO_4$ (sol.) containing $<1\%$ of H_2O , removable with increasing difficulty from 0.9% down. (IIIa) (sol.) is made by dissociation of (IIa) in vac. or in a relatively dry atm. at $\sim 100^\circ$, and is practically anhyd. (IIIb) (sol.) is made by dissociation of (IIb) in high vac. at $\sim 100^\circ$, and by rapid, nearly complete calcination of (I) at $\sim 200^\circ$; it contains 0.1—0.9% of H_2O . Heats of setting or rehydration of (IIa)—(IV) by liquid H_2O were measured directly or by heats of dissolution in dil. HCl. Heats of dissolution in HCl of (I) from 5 sources were identical. Sp. heats of (I)—(IV) in the range $53-298^\circ K.$ and entropies at $298.1^\circ K.$ were computed. Dissociation v.p. measurements of (I) and (IIb) were independent of the source of material; there was evidence of solid solution formation in the products of these dissociations. Results lead to a set of consistent thermodynamic relationships in accord with available data and explaining many existing discrepancies. An analysis of plant operating data of the heat utilisation in the gypsum-plaster kettle process for an oil-fired and a gas-fired kettle accounts for $\sim 90\%$ of the total heat supplied, of which $\sim 10\%$ is usefully consumed. N. M. B.

Decomposition and alteration of feldspars and spodumene by water. L. C. Armstrong (*Amer. Min.*, 1940, 25, 810—820).—Specimens of microcline (I), albite (II), and kunzite (III) were reduced to particles $<0.1 \mu$. by grinding in H_2O in an agate mortar for <394 hr. Electrodialysis of the suspensions produced showed that all the constituents of the minerals diffused through the membrane. This indicated that these constituents were present in the ionic state, and that clay minerals may form, at least in part, by ionic reactions. The feldspars lost $>50\%$ of their alkalis, and the rate of dissolution of their components was $CaO > Na_2O > K_2O > SiO_2 > Al_2O_3$. SiO_2 dissolved more readily from (II) than from (I). (III) lost 44% of its Li_2O , and small amounts of SiO_2 and Al_2O_3 . The decomposed minerals were hydrated considerably; $\sim 50\%$ of the H_2O was retained at 100° , and a small amount at 500° . Dehydration curves of the decomposed minerals are smooth, indicating that much H_2O was present probably as adsorbed and not as crystal lattice H_2O . X-Ray patterns showed that considerable amounts of feldspars and (III) remained in the residues after dialysis, and gave no evidence of the formation of a new mineral. After treatment of the decomposed materials in H_2O in a bomb at 300° , X-ray evidence of the formation of quartz, and of kaolinite (?), was obtained. The feldspar and (III) lines were more intense, indicating that the particles of these minerals had increased in size during the hydrothermal treatment. L. S. T.

BRITISH CHEMICAL AND PHYSIOLOGICAL ABSTRACTS

A., I.—General, Physical, and Inorganic Chemistry

AUGUST, 1941.

I.—SUB-ATOMICS.

Interaction of atomic energy levels. T. S. Subbaraya, K. Seshadri, and N. A. N. Rao (*Current Sci.*, 1941, 10, 71—74).—Lines of Sn and Hg which undergo modification in intensity on admixture of Sn and Hg are given and probable explanations are advanced (cf. A., 1940, I, 305). W. R. A.

Carbon arc spectra of europium, gadolinium, and samarium in small quantities. J. M. López de Azcona (*Anal. Fis. Quím.*, 1941, 37, 30—47).—The persistence of arc lines between 2200 and 5000 Å. for these elements in quantities of 2×10^{-4} , 2×10^{-5} , 2×10^{-6} , and 2×10^{-7} g. is studied. The nos. of persistent lines observed are respectively: for Eu, 231, 33, 13, 3; for Gd, 310, 112, 16, 1; and for Sm, 425, 172, 21, —. Tables of persistent lines and of ultimate lines are given. F. R. G.

Electron emission of metals in electric fields. I. Explanation of the periodic deviations from the Schottky line. E. Guth and C. J. Mullin (*Physical Rev.*, 1941, [ii], 59, 575—584; cf. Seifert, A., 1939, I, 589).—Mathematical. The deviations observed in measuring the thermionic emission of electrons from W and Ta are attributed to the partial reflexions of the electron waves on the potential hill at the surface of the metal giving rise to interference and thus to a periodic term in the transmission coeff. for the escaping electrons. The calc. positions of the max. and min. and the independence of temp. agree with observation; the amplitude decreases with rise of temp. The calc. amplitude of the deviations increases with the field, as does the observed amplitude. A dependence on the work function of the emitting metal is obtained. N. M. B.

Calorimetric method of measurement of loss of energy of fast electrons in lead, due to radiation. K. D. Sinelnikov, A. K. Valter, and A. V. Ivanov (*Bull. Acad. Sci. U.R.S.S., Sér. Phys.*, 1940, 4, 273—278).—Apparatus is described, depending on comparison of heat production in a Li and a Pb vac. calorimeter during exposure to a monochromatic electron beam. The results are in agreement with those calc. from the theory of Bethe *et al.* (A., 1934, 1150). R. T.

Ionisation by meteors. J. A. Pierce (*Physical Rev.*, 1941, [ii], 59, 625—626).—Experimental evidence of atm. ionisation by meteoric bombardment is presented and discussed. N. M. B.

Joint action of diffusion and recombination of ions. G. Jaffé (*Physical Rev.*, 1941, [ii], 59, 652—658).—Mathematical. The differential equation which describes the joint action of diffusion and recombination of ions is solved for the one-dimensional case. The decay of a given initial distribution of ions and the establishment of the steady state are treated. Anomalies observed by Gardner (cf. A., 1938, I, 110) in the recombination coeff. of O_2 , and in the establishment of the steady state in air, are explained by diffusion to the walls. N. M. B.

Energy loss of heavy ions. J. Knipp and E. Teller (*Physical Rev.*, 1941, [ii], 59, 659—669).—The energy loss of heavy ions is due to collisions with electrons and with nuclei. The first process is essentially determined by the ionic charge, which in turn depends on the ratio of the velocities of the most loosely-bound electron within the ion, and of the ion. The former velocity is calc. from the Thomas—Fermi model, and the ratio of the two velocities is adjusted to empirical data. The nuclear contribution to the stopping cross-section is calc. by the classical method. Comparative experimental and calc. data are plotted throughout. N. M. B.

285 II (A., I.)

Low-velocity hydrogen-ion scattering in hydrogen, water, and ammonia. A. S. Russell, C. M. Fontana, and J. H. Simons (*J. Chem. Physics*, 1941, 9, 381—387).—The effective cross-sections for scattering of H_2 , H_2O , and NH_3 for low-velocity protons, and of H_2 for low-velocity H_2^+ and H_3^+ , have been determined. The source of low-velocity H^+ was an arc in H_2 , the construction of which, with the circuit in which it is used, is described. The effective cross-sectional area was reasonably independent of pressure over the pressure range used. The average force laws can be calc., and the energy of combination for H_2 and NH_3 can be estimated. A val. of 3.5 e.v. is obtained for the proton affinity of H_2 , and 9.4 e.v. for that of NH_3 , assuming that the law of force holds down to the equilibrium positions. These vals. agree well with previous estimates by other methods. No curve could be obtained for the scattering of H_2^+ in H_2 , but it is known that there is a large interaction. A. J. M.

Arc discharge in mercury. B. Dasannacharya and C. Dakshinamurti (*Current Sci.*, 1941, 10, 166—167).—Voltage-current ($V-I$) characteristics are given for a d.c. arc (pressure $p = 0.5$ mm.) with varying degrees of air cooling. Without cooling V is approx. $\propto I$, but with cooling the rising characteristic is preceded by a rapid fall in V which becomes more pronounced as cooling is increased; the min. V val. (~ 23.5 v.) is approx. const., but the corresponding I val. increases with cooling. With $p < 0.2$ mm. the falling characteristic cannot be obtained, but curves for an uncooled arc with $p = 1.5$ —8.0 mm. show a min. which moves to higher V and I vals. as p increases. A. J. E. W.

Studies in mineral metabolism with the aid of artificial radioactive isotopes. VI. Cobalt.—See A., 1941, III, 526.

Performance of the Radium Institute cyclotron of the Academy of Science, U.S.S.R. I. V. Kurtschatov (*Bull. Acad. Sci. U.R.S.S., Sér. Phys.*, 1940, 4, 372—375).—Results obtained with this cyclotron are described. R. T.

New applications of induced radioactivity. S. Z. Roginski (*Bull. Acad. Sci. U.R.S.S., Sér. Phys.*, 1940, 4, 350—352).—A review. R. T.

Ionisation of atoms and formation of pairs in nuclear reactions. A. B. Migdal (*Bull. Acad. Sci. U.R.S.S., Sér. Phys.*, 1940, 4, 287—289).—Mathematical. Expressions of the probability of ionisation during radioactive decay are derived. R. T.

Excitation of γ -rays by fast neutrons of different energy. I. Nonaka (*Physical Rev.*, 1941, [ii], 59, 681).—Using 2.25—2.90-Me.v. fast neutrons from a D—D source, at. cross-section curves of Al, Si, Fe, Co, Cu, Ag, Cd, and Pb for γ -ray excitation were obtained. Results are discussed with reference to available data. N. M. B.

Absorption of fast neutrons. V. S. Dementii and D. V. Timoschtschuk (*Bull. Acad. Sci. U.R.S.S., Sér. Phys.*, 1940, 4, 315—316).—Absorption of fast neutrons from a Ra—Be source by cylindrical or plane screens of various elements (Al, Si, S, Mn, Fe, Cu, Zn, Rh, Ag, Sb, Te, W, Au) has been studied. Effective cross-sections of the (n, γ) reaction increase with increasing at. wt. of the element; this reaction appears to be due to slow neutrons. Absorption associated with the (n, α) and (n, p) reactions is of the same order of magnitude as scattering, in the case of light nuclei. R. T.

Absolute cross-section for the photo-disintegration of deuterium by 6.2-Me.v. quanta. J. A. Van Allen and N. M. Smith, jun. (*Physical Rev.*, 1941, [ii], 59, 618).—Measurements with a high-pressure ionisation chamber filled with D_2 gas

286

give a corr. weighted average val. of $11.6 \pm 1.5 \times 10^{-28}$ sq. cm. This is approx. equal to that of the Bethe-Peierls theory for zero force range (12.6×10^{-28}) and is distinctly < that predicted by any present theory when based on a reasonable val. for the force range. N. M. B.

Deuteron bombardment of oxygen. S. B. Welles (*Physical Rev.*, 1941, [ii], 59, 679).—Two WO_3 targets, one containing O_2 and the other an equal amount of O_2 enriched in ^{17}O and $^{18}\text{O}_2$, were bombarded with 3.7-Me.v. deuterons, and the intensity of 114-min. activity of ^{18}F was measured. The increase for the enriched target amounted to a factor of 19, agreeing with an expected enrichment factor of ~ 20 for ^{17}O , on account of the more rapid approach to concn. equilibrium of ^{17}O , rather than 9, as would be indicated by the separation factor 81 of ^{18}O . N. M. B.

Nuclear isomerism of bromine. L. I. Rusinov and A. A. Juzefovitch (*Bull. Acad. Sci. U.R.S.S., Sér. Phys.*, 1940, 4, 320—326).— γ -Radiation of $^*\text{Br}$ has $\lambda = 1 \text{ m}\mu$, corresponding with the $K\alpha$ line of the X-ray spectrum of Br. The absorption coeffs. of the radiation are of the same order of magnitude in Pb and Hg, showing that the reaction is $^*\text{Br-I} \xrightarrow{\beta} \text{Br-II} \xrightarrow{\beta} \text{Br}$, but not $^*\text{Br-I} \xrightarrow{\beta} \text{Kr} \xrightarrow{\gamma} \text{Br}$. The results are in accordance with Bohr's theory of nuclear isomerism. The excitation energy of the metastable nucleus and its internal conversion coeff. are determined. R. T.

Metastable state of the gadolinium nucleus. I. V. Kurtshatov (*Bull. Acad. Sci. U.R.S.S., Sér. Phys.*, 1940, 4, 327—329).—Capture by Gd of neutrons slowed by paraffin leads to formation of unstable nuclei, which undergo internal transformation with emission of electrons of energy $\sim 100 \text{ ke.v.}$ R. T.

Phase transformations of nuclear matter. I. I. Gurevitch (*Bull. Acad. Sci. U.R.S.S., Sér. Phys.*, 1940, 4, 330—331).—Abrupt changes in the energy parameters of at. nuclei take place at certain definite temp. This is ascribed to phase transformations of nuclear matter. R. T.

Radioactivity of ^{56}Mn and ^{128}I . R. H. Bacon, E. N. Grise-wood, and C. W. van der Merwe (*Physical Rev.*, 1941, [ii], 59, 531—538).—In order to eliminate discrepancies in existing data, the β -ray spectra and accompanying γ -rays were examined with crit. regard to difficulties of cloud-chamber technique. Results appear to fit the Fermi rather better than the Konopinski-Uhlenbeck theory. N. M. B.

Statistics of excited energy states of nuclei. H. Margenau (*Physical Rev.*, 1941, [ii], 59, 627—632).—Using a model of free particles moving in a spherical well, the spacing of nuclear energy levels at excitation energies of $\sim 8 \text{ Me.v.}$ is calc. by numerical summation over the individual particle states, thus avoiding the use of asymptotic Sommerfeld formulæ of doubtful validity for nuclear cases. Results indicate that deviations from Bethe's formula for the level density can be very great. The group structure introduced by the free-particle model has a strong effect on the spacing. The fluctuations explain the general absence, contrary to current theory, of the property of strong absorption of slow neutrons by heavy nuclei. N. M. B.

Fission of [atomic] nuclei. A. I. Leipunski (*Bull. Acad. Sci. U.R.S.S., Sér. Phys.*, 1940, 4, 291—299).—A review. R. T.

Ranges and energy of uranium fragments arising from nuclear fission under bombardment with fast neutrons. K. A. Petrshak (*Bull. Acad. Sci. U.R.S.S., Sér. Phys.*, 1940, 4, 301—304).—Fission of U nuclei following capture of fast neutrons leads to production of two groups of fragments, range 14 and 20 mm. in air, and energies 60 and 85 Me.v., respectively. R. T.

Chemical nature of products of fission of heavy nuclei. V. G. Chlopin (*Bull. Acad. Sci. U.R.S.S., Sér. Phys.*, 1940, 4, 305—309).—The following schemes of β -degradation of ^{92}U are probable: $\text{Mo} \leftarrow \text{Nb} \leftarrow \text{U} \rightarrow \text{Sb} \rightarrow \text{Te} \rightarrow \text{I} \rightarrow \text{Xe} \rightarrow \text{Cs} \rightarrow \text{Ba} \rightarrow \text{La} \rightarrow \text{Ce}$; $\text{Pr} \leftarrow \text{Ce} \leftarrow \text{U} \rightarrow \text{Se} \rightarrow \text{Br} \rightarrow \text{Kr} \rightarrow \text{Rb} \rightarrow \text{Sr} \rightarrow \text{I} \rightarrow \text{Zr}$. R. T.

Fission of uranium. L. I. Rusinov and G. N. Flerov (*Bull. Acad. Sci. U.R.S.S., Sér. Phys.*, 1940, 4, 310—314).—Fission of U by thermal neutrons is associated with emission of 2—4 secondary neutrons. Resonance neutrons do not cause fission. Only ^{235}U is affected by thermal neutrons. R. T.

Fission products of uranium by fast neutrons. Y. Nishina, T. Yasaki, K. Kimura, and M. Ikawa (*Physical Rev.*, 1941, [ii], 59, 677).—Experiments are described showing that the recently reported (cf. A., 1941, 1, 189) decay curve of Ru (60 hr.) was in reality the superposition of the growth and decay curve of Rh (34 hr.) produced from Ru (4 hr.) and the decay curve of a Ru isotope of a few months' period. N. M. B.

Fission of uranium by α -particles. E. Fermi and E. Segrè (*Physical Rev.*, 1941, [ii], 59, 680—681).—A thin layer of NH_4 uranate was bombarded with 32-Me.v. α -particles from a cyclotron. Chemical tests revealed the presence of the following fission products of U: I (54 min. and 3.4 hr.), ^{133}I (22 hr.), and ^{131}I (8 days). A compound nucleus of U and α -particles would probably be 5—10 Me.v. < the kinetic energy of the α -particle, leaving an excitation amply sufficient to produce fission of the compound nucleus. N. M. B.

Nature and constitution of cosmic radiation. D. V. Skobeltzyn (*Bull. Acad. Sci. U.R.S.S., Sér. Phys.*, 1940, 4, 233—247).—A review of current theories shows that they are in many respects contradictory. R. T.

Number of decay electrons accompanying penetrating corpuscular radiation. K. I. Alexeeva (*Bull. Acad. Sci. U.R.S.S., Sér. Phys.*, 1940, 4, 248—253).—The soft components of radiation generated by decay electrons in the atm., not penetrating a thickness of wood equiv. to 160 cm. of H_2O , amount to $\geq 8\% \pm 2$ of total penetrating radiation. R. T.

Cascade theory and experimental data. S. N. Vernov (*Bull. Acad. Sci. U.R.S.S., Sér. Phys.*, 1940, 4, 254—259).—Discrepancies between experimental results for transmission of cosmic radiation through air and Pb and those expected on the basis of the cascade theory of Bhabha and Heitler (A., 1937, I, 440) are removed by introducing corrections for scattering and for the presence of particles of penetrating power > that allowed for in the theory. R. T.

Slow mesotrons in cosmic radiation. V. I. Veksler and N. A. Dobrotin (*Bull. Acad. Sci. U.R.S.S., Sér. Phys.*, 1940, 4, 260—265).—Measurements at sea level and at 4200 m. show the presence of two groups of particles which ionise more intensely than do fast electrons. One group increases with altitude, and consists of slow secondary mesotrons, whilst the second group consists of slow protons. R. T.

Peculiarities of splitting of atomic nuclei by cosmic rays. A. P. Shdanov (*Bull. Acad. Sci. U.R.S.S., Sér. Phys.*, 1940, 4, 266—272).—Heavy charged particles produce characteristic tracks in photographic emulsions. Most of the tracks are due to protons originating from nuclei split by cosmic rays, but tracks due to α -particles also appear. Showers of protons or of protons and mesotrons were also observed, consisting in most cases of 3—4 particles, although in one case > 100 particles were counted. The rate of splitting rises rapidly with increasing altitude. R. T.

Production of hard corpuscular radiation. F. F. Lange and V. S. Schpinel (*Bull. Acad. Sci. U.R.S.S., Sér. Phys.*, 1940, 4, 353—366).—A review. R. T.

Motion of mesons in electromagnetic fields. I. Tamm (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 551—555).—Mathematical. The motion of a charged particle of spin 1 in a Coulomb field and its interaction with high-frequency photons depend on the size of the particle, whilst the opposite is true for a particle with spin 0 or $\frac{1}{2}$. This arises from the fact that, unlike electrons, the particles with spin 1 (mesons) possess what is defined as a true magnetic moment. W. R. A.

Secondary mesons. V. I. Veksler and N. A. Dobrotin (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 560—562).—The ranges of secondary mesons are small and hence their kinetic energy contributes only a small fraction of the total energy. W. R. A.

Differential measurement of the meson lifetime. W. M. Nielsen, C. M. Ryerson, L. W. Nordheim, and K. Z. Morgan (*Physical Rev.*, 1941, [ii], 59, 547—553).—Measurements were made by comparing the Pb absorption curves of cosmic radiation at two different elevations, and by compensating the air column at the higher level by a layer of graphite on top of the counter telescope. Results are independent of the energy distribution or of the height of the producing layer. The val.

found is $(1.25 \pm 0.3) \times 10^{-6}$ ($\mu\text{c}^2/10^8$ c.v.) sec., which is < available data (cf. Rossi, A., 1940, I, 187; Neher, *ibid.*).

N. M. B.

Nature of the meson decay. L. W. Nordheim (*Physical Rev.*, 1941, [ii], 59, 554—555).—In view of the smaller new val. of the meson lifetime (cf. preceding abstract), theoretical vals. for the intensity of the soft component due to meson decay are compared with experimental data. N. M. B.

Mean life of slow mesotrons. F. Rasetti (*Physical Rev.*, 1941, [ii], 59, 613).—A preliminary report of a new arrangement of counters to measure a decay curve of mesotrons at rest; the resulting val. is 3.1 ± 1.5 μ -sec. N. M. B.

Fine structure pattern of cosmic rays at Mexico City. II. E. J. Schremp and A. Baños, jun. (*Physical Rev.*, 1941, [ii], 59, 614).—Results previously reported (cf. A., 1941, I, 3) are extended, and features of the intensity pattern and properties of the radiation are deduced and discussed. N. M. B.

Nature of the primary cosmic radiation and the origin of the mesotron. M. Schein, W. P. Jesse, and E. O. Wollan (*Physical Rev.*, 1941, [ii], 59, 615; cf. A., 1940, I, 308).—The intensity curve of the hard component for various Pb thicknesses as a function of pressure shows a continuous intensity increase to the highest altitudes. Several lines of evidence indicating that the primary cosmic radiation consists of protons, and not of electrons or mesotrons, are reported and discussed. N. M. B.

Burst production by mesotrons of spin one-half and zero magnetic moment. S. B. Batdorf and R. Thomas (*Physical Rev.*, 1941, [ii], 59, 621—624).—Mathematical. The cross-section for the initiation of energetic cascades or bursts by bremsstrahlung is calc. for a mesotron of spin $\frac{1}{2}$ or 0 magnetic moment. Results are similar to Christy's for a Proca particle, the cross-section being ~ 0.7 of that recorded (cf. A., 1941, I, 235). N. M. B.

Geomagnetic character and cosmic-ray intensity pulses. J. W. Broxon (*Physical Rev.*, 1941, [ii], 59, 678—679).—A close relationship between the pulses in cosmic-ray intensity and terrestrial magnetic disturbances has been discovered by application of Chree's method of geomagnetic analysis. N. M. B.

Neutrino theory of stellar collapse. G. Gamow and M. Schoenberg (*Physical Rev.*, 1941, [ii], 59, 539—547).—Mathematical. A theory of neutrino energy losses in contracting stars is proposed, and a formula for the rate of these losses as a function of temp. and density is developed (see also following abstract). N. M. B.

Relative importance of different elements for neutrino production. G. Gamow (*Physical Rev.*, 1941, [ii], 59, 617—618).—A diagram is constructed to show the relative importance of different elements for the energy losses through neutrino emission in contracting stars (cf. preceding abstract) taking into account the abundance of the elements and the known decay energies and decay periods of the corresponding unstable nuclei. The effect of different factors on the rate of energy losses is discussed. N. M. B.

Exchange properties of the neutron-proton interaction. W. Rarita and J. Schwinger (*Physical Rev.*, 1941, [ii], 59, 556—564; cf. A., 1941, I, 236).—Mathematical. Information on the interaction in odd parity states can be gained only by observations on high-energy neutron-proton scattering and deuteron photo-disintegration by energetic γ -rays. Calculations are made for three types of interactions, analogous to the potentials predicted by "symmetrical," "charged," and "neutral" mesotron theory, in order to test the sensitivity of such experiments to variations of the exchange operator dependence of the interaction. Results for total cross-sections and angular distributions in the centre of mass system are given, as well as the electric dipole total cross-sections and angular distributions predicted by the three theories. High-energy photo-disintegration angular measurements constitute the most sensitive test of isotopic spin dependence of the neutron-proton interaction and the existence of non-central forces. N. M. B.

Non-uniform particle density in nuclear structure. E. Feenberg (*Physical Rev.*, 1941, [ii], 59, 593—597).—Mathematical. A variation of the proton density within a nucleus due to Coulomb repulsion between protons creates forces which distort the neutron distribution. Neglecting surface effects, the

energy correction associated with the non-uniform densities is calc. The departure from uniform density is appreciable in heavy nuclei, but the energy correction is negligible.

N. M. B.

Interaction of electrons in metals and insulators. C. W. Ufford (*Physical Rev.*, 1941, [ii], 59, 598—608).—Mathematical. The electrostatic energy of electrons in a lattice is calc. by the Rayleigh-Schrödinger perturbation method. For a metal, this method gives a val. which becomes logarithmically infinite; for an insulator the gap in energy above the first occupied zone leads to a finite result.

N. M. B.

Einstein condensation phenomenon. W. E. Lamb, jun., and A. Nordsieck (*Physical Rev.*, 1941, [iii], 59, 677).—An application of the results of Goldstein (cf. A., 1941, I, 236) to the case of a gas in a gravitational field. N. M. B.

An aspect of the materialisation of energy according to Dirac's theory. O. R. Foz (*Anal. Fís. Quím.*, 1941, 37, 22—24).—Dirac's theory is considered to be equiv. to the photon emission accompanying the transference of an electron from one energy level to another. F. R. G.

II.—MOLECULAR STRUCTURE.

Intensity measurements in the molecular spectrum of hydrogen. N. Ginsburg and G. H. Dieke (*Physical Rev.*, 1941, [ii], 59, 632—644).—Quant. intensity measurements of the H_2 spectrum in the visible and infra-red were made for different conditions in the discharge tube, and data for the Fulcher bands are reported. At the lower pressures no equilibrium appears to exist and hence the concept of temp. has no meaning. By varying the pressure and current in the discharge tube the effective rotational temp. can be varied from 240° to 1500° K. Whereas higher rotational states are favoured by an increase in pressure, the higher vibrational states are suppressed, and this effect is largely independent of the current. From the behaviour of the relative intensities with changes of pressure and c.d. conclusions can be drawn regarding the elementary processes in the discharge. Results show the need for extreme care when using band-spectra intensity measurements for temp. measurements, and that transition probabilities may be quite different from the vals. predicted by elementary theory. N. M. B.

New ($2 \rightarrow 2$) band in the spectrum of OD. A. L. Narayan (*Current Sci.*, 1941, 10, 75).—In the region 3100—3250 Å. 200 lines of the band system of OD have been measured precisely; 90 of them form the six principal branches of the new $2 \rightarrow 2$ band. W. R. A.

Band spectrum of sodium hydride. R. C. Pankhurst (*Nature*, 1941, 147, 643).—New bands of NaH have been measured in the region $\lambda\lambda$ 4900—6400. Rotational constns. are recorded for the lower levels ($v' = 1, 2, 3$) of the upper state and for levels of the ground state. L. S. T.

Vibrational structure of the $^2\Sigma_g^+ \leftarrow ^1\Sigma_g^+$ Rydberg series of N_2 . Y. Tanaka and T. Takamine (*Physical Rev.*, 1941, [ii], 59, 613).—In the region 938—784 Å., twelve (1,0) bands of the Worley-Jenkins series (cf. A., 1938, I, 543) were found. The limit of the (1,0) bands lies at 782.26 Å., or 15.77 v. N. M. B.

New absorption spectra of the alkaline-earth fluorides. C. A. Fowler, jun. (*Physical Rev.*, 1941, [ii], 59, 645—652).—Investigation under high dispersion reveals several new band systems in the ultra-violet as far as 1950 Å. Wave-no. residuals and estimated intensities are tabulated. Vibrational analyses give the vibration frequencies and electronic terms of one new state of MgF, 3 of CaF, 4 of SrF, and 4 of BaF. Previous analyses of the $A \rightleftharpoons X$ system of MgF and the $C \rightleftharpoons X$ system of CaF are revised. An increased binding in all these higher-energy states as indicated by the vals. of the constns. is discussed with reference to the probable electron configurations. N. M. B.

Visible absorption bands of mercuric chloride. A. L. S. Rao (*Current Sci.*, 1941, 10, 169).—A system of doublet bands at 4200—4900 Å., containing three well-defined sequences, has been observed in the absorption spectrum of HgCl_2 vapour at 1000° . The bands are ascribed to HgCl , and probably form part of Wieland's class III system (cf. A., 1929, 1127; 1930, 652; 1932, 981). A. J. E. W.

Ultra-violet emission bands of mercuric chloride. M. G. Sastry (*Current Sci.*, 1941, 10, 169).—A detailed analysis of the band system at 2700–2900 Å. (Wieland; cf. preceding abstract) confirms its assignment to HgCl_2 , and a previous vibrational analysis (Cornell, A., 1938, I, 551). Bands forming the Q_2 sequences of the system have been observed on the short- λ side of the Q_1 sequences, the doublet separation being $\sim 90 \text{ cm}^{-1}$. The system is ascribed to a $^2\Pi - ^2\Sigma$ transition, the lower state of which is probably identical with that of Wieland's class I system. Vibrational consts., derived from the Q_2 heads, are: ω_e'' 287.8, ω_e'' 281.0, $x_e''\omega_e''$ 0.5, $x_e''\omega_e''$ 0.5; ν_e is 36,564.2. A. J. E. W.

Near infra-red spectrum of water vapour. I. Perpendicular bands of ν_2 and $2\nu_2$. H. H. Nielsen (*Physical Rev.*, 1941, [ii], 59, 565–575; cf. Randall, A., 1937, I, 495; Darling, A., 1940, I, 146).—Remeasurement data for the rotation-vibration ν_2 and $2\nu_2$ bands in the bolometric infra-red, and an analysis of the rotational structure, are reported. The calc. normal frequency ν_2 is 1653.8 cm^{-1} , and the anharmonic const. U_{22} is -19.25 cm^{-1} . Vals. of the moments of inertia effective in the two vibration states are given. Results confirm the theory of the H_2O vapour mol. N. M. B.

Infra-red spectra of SiH_4 and GeH_4 . C. H. Tindal, J. W. Straley, and H. H. Nielsen (*Proc. Nat. Acad. Sci.*, 1941, 27, 208–212).—An extension of previous work (A., 1941, I, 71). Vals. for SiH_4 and GeH_4 respectively are: ν_2 , 975 and 932; ν_3 , 2191 and 2114; ν_4 , 910 and 818 cm^{-1} . These lead to vals. of 0.997 and 1.059 $\times 10^{-39} \text{ g.-cm}^2$ respectively for the moments of inertia and 1.50 and 1.54 $\times 10^{-8} \text{ cm}$, respectively for the N—H distance. W. R. A.

Raman effect in gypsum. D. A. A. S. N. Rao (*Proc. Indian Acad. Sci.*, 1941, 13, A, 137–149).—The Raman spectrum of gypsum contains six frequencies with shifts 415, 491, 617, 673, 1006, and 1132 cm^{-1} due to SO_4^{2-} and two bands at 3405 and 3489 cm^{-1} due to H_2O of crystallisation. The appearance of so many lines does not imply a lack of tetrahedral symmetry in the SO_4 group but may be ascribed to the low degree of symmetry possessed by the crystal itself. In 12 spectrograms corresponding with different orientations of the crystal, the total symmetric line 1006 cm^{-1} is always nearly the strongest, and the lattice lines do not appear with sufficient intensity in any case; this behaviour is characteristic of this crystal. The total symmetric line is depolarised to an appreciable extent in all the cases. The behaviour of the 1132 cm^{-1} line is reciprocal to that of 1006 cm^{-1} in almost all the cases. The behaviour of the 3405 and 3489 cm^{-1} bands is reciprocal. These and the 1006 and 1132 cm^{-1} lines belong respectively to the symmetric and antisymmetric classes. H. W.

Spectroscopic evidence for hydrogen bonds: comparison of proton-attracting properties of liquids. IV. W. Gordy (*J. Chem. Physics*, 1941, 9, 440).—A correction (A., 1941, I, 239). A. J. M.

Hindered rotation in halogenated ethanes. G. Glockler and C. Sage (*J. Chem. Physics*, 1941, 9, 387–389).—The Raman spectra of some halogenoethanes have been investigated. The results show that if only "staggered" (as opposed to "eclipsed") forms are regarded as stable configurations, the compounds can be divided into three groups: (1) those which may have only one mol. configuration, CF_3CCl_3 and CCl_3CHFCl ; (2) those which may have two rotational isomerides, $(\text{CF}_2\text{Cl})_2$, $\text{CF}_2\text{Cl}-\text{CFCl}_2$, $\text{CF}_2\text{Cl}-\text{CHF}_2$, and $(\text{CF}_2\text{Br})_2$; (3) those which may have three rotational isomerides, $\text{CF}_2\text{Br}-\text{CFClBr}$ and $\text{CF}_2\text{Cl}-\text{CHFCl}$. The no. of observed lines increases as the no. of possible isomeric forms increases, although there is not complete correspondence between the theoretical no. of active vibrations and the no. of observed lines. This may be due to some of the lines being overtones or combination frequencies, to the fact that the isomerides may be present in such small concn. that only the more intense lines are obtained, and to some of the frequencies being nearly the same for all isomerides. The valency vibrations are not appreciably affected by the rotational orientation of the two halves of the mol. A. J. M.

Raman spectra of acetylenes. IV. Carbon isotope effect in acetylenes. F. F. Cleveland and M. J. Murray (*J. Chem. Physics*, 1941, 9, 390–392).—The C isotope shift in the frequency near 2200 cm^{-1} has been calc. for $^{13}\text{CH}_3^{12}\text{CH}$, $^{12}\text{CMe}^{13}\text{CH}$, $^{13}\text{CMe}^{12}\text{CH}$, and $^{12}\text{CMe}^{13}\text{CMe}$, using the same

potential function in each case, and assuming a four-mass linear oscillator. The calc. shifts were -27 , -26 , -50 , and -33.5 cm^{-1} , respectively. It is probable that the magnitude of isotope shifts in other mono-substituted acetylenes will be nearly the same as those calc. for the methylacetylenes. Weak lines which may correspond with isotope shifts were actually found for the mono-substituted acetylenes Δ^a -heptene (-21 and -53 cm^{-1}), δ -methoxy- Δ^a -butene (-24 and -53 cm^{-1}), and $\text{CPh}:\text{CMe}$ (-24 and -54 cm^{-1}), and for the disubstituted acetylenes α -phenyl- Δ^a -butin- γ -one (-37 cm^{-1}), α -phenyl- Δ^a -butin- γ -ol (-33 cm^{-1}), α -phenyl- Δ^a -butene (-29 cm^{-1}), Δ^a -hexene (-26 cm^{-1}), Δ^a -octene (-36 cm^{-1}), and Δ^a -decene (-38 cm^{-1}). A. J. M.

Infra-red absorption spectra of some amino-compounds. I. Kellner (*Proc. Roy. Soc.*, 1941, A, 177, 447–456).—The materials examined were glycine (I), 2:5-diketopiperazine (II), tetramethyldiketopiperazine (III), glycyglycine (IV), and $\text{CO}(\text{NH}_2)_2$ (V). Observations of infra-red spectra were carried out in the range 2.8–3.6 μ . The results are discussed in relation to the mol. structure of the compounds. The no. and position of the N—H frequencies in (I) and (IV) show that these mols. are in the zwitterion form in the crystal. The similarity between the spectra of (II) and (III) on the one hand and those of the NH_2 -acids and (V) on the other proves that no lactam-lactim interchange occurs in (II) and (III). Both compounds possess a centre of symmetry. In all the substances resonance between C—N and C=O bonds takes place. [For the discussion of the spectrum of (V) see following abstract.] G. D. P.

Vibrations and molecular structure of carbamide and guanidonium. L. Kellner (*Proc. Roy. Soc.*, 1941, A, 177, 456–475; cf. preceding abstract).—The vibrations of $\text{CO}(\text{NH}_2)_2$ and $\text{CO}(\text{ND}_2)_2$, and of $\text{C}(\text{NH}_2)_3$ and $\text{C}(\text{ND}_2)_3$, have been calc. for a field containing valency and angle forces. The observed frequencies are assigned to definite modes of vibration and the force consts. are evaluated. In $\text{CO}(\text{NH}_2)_2$ the C—N bond has approx. 28% double bond character and the C=O a corresponding single bond character. Guanidonium shows complete resonance, each C—N bond being one third double. G. D. P.

Effect of crystal orientation on the Raman effect in naphthalene and benzophenone. T. M. K. Nedungadi (*Proc. Indian Acad. Sci.*, 1941, 13, A, 161–176).—Single crystals of C_{10}H_8 exhibit 4 lattice and 28 internal vibrations (8 new displacements) and those of COPh_2 give 3 lattice and 19 internal oscillations (4 new). Molten COPh_2 shows 27 lines (6 new), of which 15 are polarised. The influence on the intensities of Raman lines of different crystal orientations and of different directions of incidence and states of polarisation of exciting radiation has been investigated. W. R. A.

Ultra-violet absorption spectra of metallo-porphyrins and their compounds with globin. H. F. Holden (*Austral. J. Exp. Biol.*, 1941, 19, 1–8).—Data for the ultra-violet absorption spectra of protoporphyrin compounds of Cu, Ni, Co, and Zn in $\text{C}_6\text{H}_5\text{N}-\text{CHCl}_3$, $\text{EtOH}-\text{HCl}$, and H_2O , and in presence of globin, are given and discussed. F. O. H.

Measurements of dispersion of light by skim milk. W. Lotmar and H. Nitschmann (*Helv. Chim. Acta*, 1941, 24, 242–247).—Casein of natural skim milk exists as a light-dispersing system at the upper limit of validity of Rayleigh's theory. Addition of alkali causes dispersion of the particles with diminution of the intensity of dispersion to 0.002 and an equally pronounced diminution of particle vol. The val. of the degree of depolarisation indicates an upper limit of $\sim 120 \text{ m}\mu$. for the diameter of the particles of neutral skim milk and therefore a limit of $\sim 15 \text{ m}\mu$. for those of the alkaline liquid. These data agree satisfactorily with those obtained by ultracentrifuging. The vals. also establish spherical form or at least spherical symmetry for native casein but the shape of these dispersed particles cannot be defined. H. W.

The property $(\delta u/\delta v)_T = 0$ of perfect gases, the second law of thermodynamics, and the fundamental hypothesis underlying kinetic-statistics. O. R. Foz (*Anal. Fis. Quím.*, 1941, 37, 25–29).—Joule's law is empirical and cannot be derived from the equation of state and the second law of thermodynamics. Possible sources of error in the derivation of the thermodynamic theory are discussed, in particular those arising from the application of the classical laws of mechanics to dimensions of the order of mols. F. R. G.

Second virial coefficients of polar gases. W. H. Stockmayer (*J. Chem. Physics*, 1941, 9, 398—402).—An equation is given for the second virial coeff. of a polar gas in terms of the parameters appearing in the expression for intermol. potential energy, which includes London and dipole attraction and inverse-power repulsion. The equation is applied to NH_3 and steam. The London consts. obtained agree satisfactorily with theoretical estimates. The defects of the model and its relation to the concept of the H bond are discussed in particular connexion with the calculation of the second virial coeff. of steam. A. J. M.

Partition function for normal liquids. J. Walter and H. Eyring (*J. Chem. Physics*, 1941, 9, 393—397).—A theory of liquids is developed which gives a picture of the rate processes as well as the thermodynamic properties of liquids. It is assumed that the mols. are distributed at random among solid-like and gas-like equilibrium positions. The introduction of a new equilibrium position requires a vol. increase about $\frac{1}{2}$ of the mol. vol. The theory is applied to liquid A, liquid N_2 , and C_6H_6 , with satisfactory results. It may also be applied successfully to the calculation of the thermodynamic properties of liquid metals. A. J. M.

Alleged dimeric constitution of ethylenediaminocupric chloride. K. L. Mandal (*Current Sci.*, 1941, 10, 78).—Polemical against Chattaway and Drew (*A.*, 1937, 1, 420). W. R. A.

III.—CRYSTAL STRUCTURE.

Diffuse scattering of X-rays by rock-salt. R. Q. Gregg and N. S. Gingrich (*Physical Rev.*, 1941, [ii], 59, 619—621).—A "monochromatic Laue pattern" obtained with crystal-reflected Mo $K\alpha$ radiation shows 40 diffuse spots. The positions, intensities, and half-widths at half-max. show good agreement with the predictions of Zachariasen (*cf. A.*, 1940, 1, 285). N. M. B.

X-Ray study of the structure of rectifying selenium films. G. L. Clark and P. G. Roach (*Trans. Electrochem. Soc.*, 1941, 79, *Preprint* 22, 269—279).—X-Ray investigations show that thin Se films, formed by spreading molten Se on Fe, Ni, or Ni-plated Fe strips, change from the amorphous to the hexagonal form on heating at 100—120°, but the resistance of these films is high and they show no rectifying properties. Heating at 200° leads to an increase in crystal size, with rapid decrease in resistance and development of rectifying action. Oxide and selenide films at the Se-metal interface do not produce a high resistance, and the rectifying action occurs at the Se-counter electrode interface. Impurities have only slight effects on resistance and rectifying properties. Polishing of the Se films leads to an increase in resistance and a very great increase in rectifying action. Treatment of amorphous films with $\text{NHPh}\cdot\text{NH}_2$ yields hexagonal cryst. films with preferred orientation, a factor detrimental to rectifier action; treatment with quinoline yields randomly oriented hexagonal films with good rectification. Films of monoclinic Se produced by the action of abs. EtOH on the amorphous film are unaffected by $\text{NHPh}\cdot\text{NH}_2$. J. W. S.

Structure of vitreous silica. S. S. Lu and Y. L. Chang (*Nature*, 1941, 147, 642—643).—Debye-Scherrer photographs show the presence of two strong and six weak, diffuse bands, and three sharp lines which appear in certain cases. Positions and spacings are tabulated. The band corresponding with 7.1 Å. could not be identified. Differences between the Debye-Scherrer and pin-hole transmission photographs have been traced to changes in structure produced by powdering the glass. In the transmission photographs the relative intensities of the two strong bands may change with different locations of the same specimen. This supports the view that large fluctuations occur in vitreous SiO_2 . L. S. T.

Deformation and recrystallisation of copper and brass; hardness, microstructure, and texture changes. R. M. Brick and M. A. Williamson (*Amer. Inst. Min. Met. Eng.*, 1941, *Tech. Publ.* 1299, 8 pp.; *Met. Tech.*, 1941, 8, No. 2).—Samples of polycryst. Cu and Cu-Zn alloys with 7—36% of Zn, having a grain size of 0.045 mm., and single crystals of 70—30 brass, were cold-rolled and subsequently annealed at various temp. The changes in hardness and texture are shown in curves and octahedral pole figures. The Cu samples

when straight-rolled on 4-in. rolls hardened > when turned 90° at each pass, but no such difference was noted when Cu slabs were reduced in 18-in. rolls. In the straight-rolled Cu, (110) [112] and (112) [111] structures were present, as well as some material in the hitherto unreported (110) [110] orientation (the recrystallisation texture). The single crystals of brass showed markings along the octahedral planes after 20—40% reduction, and more confused structures after greater reductions. J. C. C.

Discontinuities of magnetostriction and magnetisation in nickel. C. W. Heaps (*Physical Rev.*, 1941, [ii], 59, 585—587; *cf. Bozorth, A.*, 1932, 987).—If the magnetic vector of a domain jumps through some angle other than 180°, a sudden redistribution of strains will be caused by the change of magnetostriction and a sound wave will travel out from the domain. Simultaneous records of the sounds and magnetisation jumps when the magnetisation of a Ni wire changes have been obtained; they indicate that reversals occur mainly when the magnetisation of the specimen is weak. N. M. B.

Polar vibrations of alkali halides. R. H. Lyddane, R. G. Sachs, and E. Teller (*Physical Rev.*, 1941, [ii], 59, 673—676; *cf. A.*, 1939, 1, 63).—Mathematical. With the help of a special definition of the effective charge e^* of an ion, and without making any sp. assumptions about the detailed interactions between the ions, expressions are obtained for the frequency ω_l of the longitudinal, and the frequency ω_t of the transverse, vibration in terms of ϵ of the crystal, of ϵ_0 obtained by extrapolating n^2 of the crystal from high frequencies to zero frequency, and of e^* . The ratio of the two frequencies is found to be independent of e^* and given by $\omega_l/\omega_t = (\epsilon/\epsilon_0)^{1/2}$. N. M. B.

IV.—PHYSICAL PROPERTIES OF PURE SUBSTANCES.

Elastic modulus s_{12} of β -quartz. A. W. Lawson (*Physical Rev.*, 1941, [ii], 59, 608—612).—The adiabatic Young's modulus of β -quartz along a direction at 45° to the optic axis was measured as a function of temp. The data, with those of Atanasoff (*A.*, 1941, 1, 105), give the val. -0.226×10^{-12} sq. cm. per dyne at 600° for the adiabatic elastic modulus s_{12} . N. M. B.

Dependence of the direction of rectification in copper pyrites on voltage, temperature, and time of measurement. M. A. El-Sherbini and Y. L. Yousef (*Nature*, 1941, 147, 543).—In Cu-Cu pyrites contacts the normal direction of easy flow is from the metal below 1 v. but is reversed between 20° and 200°. With p.d. of several v. the direction is from the crystal, but is reversed between 20° and -78°. Above a crit. temp. of $\sim 500^\circ \text{K.}$, or above a crit. p.d. of $\sim 20 \text{ v.}$ extrapolated at 0° K., the direction of rectification is always the same. L. S. T.

Acoustic velocity in Rochelle salt solutions. L. Sibaiya and R. L. Narasimhaiya (*Current Sci.*, 1941, 10, 168—169).—Measurements of the velocity of sound (V m. per sec.) in aq. Na K tartrate solutions at three concns. give an extrapolated V val. of 2092 for the cryst. salt. Comparison with vals. calc. from elastic consts. (4484; *cf. Mandell, A.*, 1929, 23) or light scattering (~ 3530 ; *cf. Sibaiya, A.*, 1939, 1, 132) shows that the linear extrapolation does not give the true V val. for the crystals (*cf. Schaafs, A.*, 1937, 1, 404). The extrapolated val. is, however, characteristic of the solute, and can be used to calculate V for a solution in a solvent for which V is known. A. J. E. W.

Magnetic susceptibility of aqueous iodic acid. Constitution of iodic acid. M. R. Nayar and N. K. Mundle (*Current Sci.*, 1941, 10, 76).—0.01—1.0N. solutions of HIO_3 have been investigated; breaks in the χ -n. curve occur at 0.04N. and 0.08N. corresponding with breaks in the curves of other physical properties (*cf. A.*, 1939, 1, 198). W. R. A.

Thermal properties of pentane. P. R. Konz and G. G. Brown (*Ind. Eng. Chem.*, 1941, 33, 617—623).—The Joule-Thomson effect J has been measured for $n\text{-C}_5\text{H}_{12}$ vapour for a series of expansion steps from 3000 lb. per sq. in. at temp. up to $\sim 800^\circ \text{F.}$, the expanded vapour being led to a calorimetric condenser for enthalpy measurements. For the pressure step $E = 626\text{—}14.7 \text{ lb. per sq. in.}$ J is positive, falling continuously with rising final temp. θ_f . For $E =$

962–626 lb. per sq. in. J is negative up to $\theta_F = 250^\circ \text{ F.}$, and rises to a steep max. at $\theta_F = 460^\circ \text{ F.}$ For the higher steps effects are similar but the max. gradually decreases and shifts to higher θ_F . The enthalpy is expressed by H (B.Th.U. per lb.) = $0.000287\theta^2 + 0.315\theta + 158.7$, θ being in $^\circ \text{ F.}$ By differentiation an equation for the sp. heat is derived which agrees with known experimental vals. (cf. A.I., 1938, 21). Smoothed and extrapolated isenthalps are plotted on a pressure-temp. chart up to 5000 lb. per sq. in. and 900° F. A. R. Pe.

Boiling points of n -alkyl nitriles. A. W. Ralston, W. M. Selby, and W. O. Pool (*Ind. Eng. Chem.*, 1941, 33, 682–683).—B.p. of $\text{Me} \cdot [\text{CH}_2]_n \cdot \text{CN}$ ($n = 4$ –16) are recorded for 11 pressures, including the following: $n = 4$, b.p. $44.7^\circ/8$, $164.8^\circ/760$ mm.; 5, b.p. $48.5^\circ/4$, $188.9^\circ/760$ mm.; 6, b.p. $41.1^\circ/1$, $206.8^\circ/760$ mm.; 7, b.p. $55.0^\circ/1$, $225.9^\circ/760$ mm.; 8, b.p. $69.6^\circ/1$, $244.1^\circ/760$ mm.; 9, b.p. $82.9^\circ/1$, $260.8^\circ/760$ mm.; 10, b.p. $95.8^\circ/1$, $276.7^\circ/760$ mm.; 11, b.p. $107.6^\circ/1$, $292.8^\circ/760$ mm.; 12, b.p. $118.9^\circ/1$, $306.9^\circ/760$ mm.; 13, b.p. $130.5^\circ/1$, $322.1^\circ/760$ mm.; 14, b.p. $142.3^\circ/1$, $334.3^\circ/760$ mm.; 15, b.p. $152.3^\circ/1$, $346.7^\circ/760$ mm.; 16, b.p. $161.3^\circ/1$, $357.4^\circ/760$ mm. B.p./760 mm. accord moderately with vals. calc. according to Kinney (A., 1939, I, 134) except for C_{13} ; discrepancies are at most partly due to decomp. The nitriles are prepared from RCO_2H by passage with NH_3 over Al_2O_3 at 400° , except for those with $n = 11$, 13, and 15, which are prepared from $\text{Me} \cdot [\text{CH}_2]_{n-1} \cdot \text{I}$ by KCN. R. S. C.

The Macleod constant and its dependence on physico-chemical factors. D. T. Lewis (*J. Physical Chem.*, 1940, 44, 1007–1011).—Combination of the Macleod equation $\gamma = C(D - d)^4$ (where D and d are the densities of liquid and vapour, and C is a const.) with the law of rectilinear diameters leads to an equation $\gamma^{\frac{1}{4}} = \gamma_0^{\frac{1}{4}} \{ (1 + a) - aT/T_c \} (D - d) / \{ (1 + a)(D + d) \}$, where T_c = crit. temp., γ_0 = the val. of γ at abs. zero, and a is ~ 1 . If $a = 1$ and d is small, this becomes $\gamma^{\frac{1}{4}} = \gamma_0^{\frac{1}{4}} (2T_c - T) / 2T_c$. These equations are compared with observation. F. J. G.

Temperature coefficient of density and refractive index for hydrocarbons in the liquid state. M. R. Lipkin and S. S. Kurtz, jun. (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 291–295).—Using the equation $d_\theta^0 = d_{20}^0 + \alpha(\theta - 20) + \beta(\theta - 20)^2$, where $\alpha = \Delta d / \Delta \theta$ of the liquid, density d at 20° and 1 atm., and β is the variation of $\Delta d / \Delta \theta$ with θ , a single curve of α against mol. wt. and a single curve of β against mol. wt. have been found applicable to all types of hydrocarbons with very few exceptions. From these curves the temp. coeff. of d of a liquid hydrocarbon at atm. pressure can be predicted from the mol. wt. to within $\pm 2 \times 10^{-5}$ g. per c.c. per $^\circ \text{ C.}$ The definite exceptions are C_6H_6 , $\text{C}_6\text{H}_5\text{HET}_3$, and C_6Pr_3 ; the curves are also applicable to hydrocarbon mixtures. Since $\Delta n = 0.60 \Delta d$, an accurate method of calculating density change also provides a satisfactory method for calculating change in n . J. D. R.

Nomographs for thermal conductivities of gases and vapours. D. S. Davis (*Ind. Eng. Chem.*, 1941, 33, 675–678).—The gases and vapours are dealt with in three classes. (I) For CH_4 , NH_3 , CO_2 , and N_2O the conductivity k_θ at $\theta^\circ \text{ F.}$ is given by $k_\theta = k_{32} + a(\theta - 32)$, where a is a sp. const. (II) For NO , CO , O_2 , N_2 , H_2 , and air, $k_\theta = k_{32} (492 + C) / (\theta + 460 + C) [(\theta + 460) / 492]^{3/2}$, where C is Sutherland's const. (III) For C_2H_2 , C_2H_4 , C_2H_6 , H_2O , and a no. of org. vapours the equation $k_\theta = m [(\theta + 600) / 632]^n$, in which m and n are sp. consts., is proposed. Vals. of the consts. are tabulated and nomograms drawn whence k_θ can be found for the pure gases and vapours and for mixtures of H_2 with CO_2 , N_2O , or N_2 . A. R. Pe.

Specific viscosity and mol. wt. of cellulose. O. P. Golova and J. J. Nikolaeva (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 582–585).—The mol. wt. of cotton cellulose in a Cu-NH_3 solution has been determined by the sp. viscosity method in the presence of N_2 freed from traces of acids by several methods. In the purest N_2 employed, the mol. wt. is 720,000 and the degree of polymerisation 4300 glucose units; this is not considered as the limiting val., since traces of acids in small quantities of air present in the solution were not removed. The method has been applied to silk cellulose. A brief review of previous data is given. W. R. A.

V.—SOLUTIONS AND MIXTURES (INCLUDING COLLOIDS).

Volume change on mixing gases. A. E. Markham and K. A. Kobe (*J. Chem. Physics*, 1941, 9, 438–439).—The vol. changes occurring on mixing pairs of the gases O_2 , N_2 , CO_2 , and N_2O have been determined. With all pairs except N_2 and O_2 there is a small, but definite, increase in vol. on mixing, which is, however, \ll the increase stated to occur by Fuchs (A., 1918, ii, 298). A. J. M.

Specific gravity of aqueous ethyl alcohol. Temperature corrections. C. R. Churchward (*J. Proc. Austral. Chem. Inst.*, 1941, 8, 99–100).—Sp. gr. is determined by weighing at room temp. and correcting for temp. difference. Temp. corrections for the range 53 – 70° F. , with sp. gr. to 0.962, and applicable to Thorpe's $60^\circ/60^\circ \text{ F.}$ table, are tabulated. L. S. T.

Kinetic interpretation of osmosis. A. Niini (*Suomen Kem.*, 1940, 13, A, 57–62).—The development of the kinetic theory of osmosis is outlined and discussed. C. R. H.

Investigation of silver amalgams by electron diffraction. Z. Pinsker and L. Tatarinova (*Acta Physicochim. U.R.S.S.*, 1941, 14, 193–200).—Electron diffraction patterns of Ag and of Ag in successive stages of amalgamation have been studied. The results differ from those given by X-ray methods, and agree with those of other workers with the electron diffraction method in confirming the existence of compounds belonging to one cubic and two tetragonal phases. F. L. U.

Mechanism of precipitation from the solid solution of silver in aluminium. C. S. Barrett, A. H. Geisler, and R. F. Mehl (*Amer. Inst. Min. Met. Eng.*, 1941, *Tech. Publ.* 1275, 15 pp.; *Met. Tech.*, 8, No. 2).—Changes in the lattice during the ageing of a 20.2 wt.-% Ag-Al alloy were studied. During pptn., the alloy forms plate-like Guinier–Preston aggregates on the (111) plane, and also a transitional close-packed hexagonal lattice which is deposited on the (111) phase parallel to the equilibrium lattice. It is concluded that the various stages in pptn. are merely successive steps in a single process of lattice alteration. J. C. C.

Iron-phosphorus alloys.—See B., 1941, I, 294.

Rate of diffusion of manganese in gamma iron in low-carbon and high-carbon manganese steels. C. Wells and R. F. Mehl (*Amer. Inst. Min. Met. Eng.*, 1941, *Tech. Publ.* 1282, 13 pp.; *Met. Tech.*, 8, No. 2).—The rate of diffusion, D , of Mn across the welded interface of two bars of different composition heated in A at 1000 – 1450° was determined from the results of chemical analysis of layers subsequently machined from the specimens. D for Mn is only $\sim 1/50,000$ of that for C; it increases 125% as the Mn content is varied from 0 to 60%, it increases 350% as C content is varied from 0 to 1.5%, and it appears to be independent of grain size. The results are expressed in the form of empirical equations. J. C. C.

Copper-nickel-zirconium-aluminium alloys.—See B., 1941, I, 297.

Solubility of methane in n -hexane. E. P. Schoch, A. E. Hoffmann, and F. D. Mayfield (*Ind. Eng. Chem.*, 1941, 33, 688–691).—Sp. vols. of CH_4 - n - C_6H_{14} mixtures have been determined at 100.27° , 160° , and 220° F. under pressures up to 6000 lb. per sq. in. and are compared with data of previous workers (B., 1936, 1076; A., 1938, I, 622). Thence sp. vols. and pressures at the bubble point are plotted. The solubility of CH_4 decreases in the series $\text{C}_6\text{H}_{14} > \text{cyclohexane} > \text{C}_6\text{H}_6$ (cf. A., 1940, I, 319; 1941, I, 9). A. R. Pe.

Solubility of morphine in water. Determination of coefficients of solubility. E. Sellés (*Anal. Fis. Quím.*, 1941, 37, 119–122).—The apparatus described permits the filtration of a solute agitated in contact with its saturated solution and maintained at a regulated temp. The solubility of morphine in H_2O is recorded at regular intervals and varies continuously with temp. from 0.26 at 13° to 1.47 g. per l. at 90° . F. R. G.

Furfural[dehyde] as solvent. F. Trimble (*Ind. Eng. Chem.*, 1941, 33, 660–662).—In view of the use of furfuraldehyde as a selective solvent, the solubilities in a technically pure product of 20 org. acids, 9 other org. compounds, and 80 salts and oxides are tabulated. Inorg. salts are usually

insol. at room temp., but ZnCl_2 , $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$, $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$, and $\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$ are sol. Saturated aliphatic hydrocarbons show limited solubility, but aromatic hydrocarbons are completely miscible. S. M.

Nature of the adsorption of fatty acids from organic solvents by inorganic lead compounds. A. Knoll and D. L. Baker (*Amer. Inst. Min. Met. Eng.*, 1941, *Tech. Publ.* 1314, 4 pp.).—Powdered galena removes fatty acids from solutions of these acids in non-aq. solvents. The particles produced are not wetted by PhNO_2 and are highly H_2O -repellent. The adsorption of fatty acid is attributed to reaction of the acid with the Pb salts in the surface forming films of Pb soaps. Similar films are formed on cerussite but not on anglesite. J. W. S.

Permeability in monolayers. F. Sebba and E. K. Rideal (*Trans. Faraday Soc.*, 1941, **37**, 273—278).—The apparatus previously described (A., 1940, I, 160) was used to determine the permeability (P) of various monolayers to H_2O vapour. Protein and tanned protein are freely permeable. P of cetyl alcohol is approx. that of its complex with Na cetyl sulphate. P of a mixed film of eicosoic acid and docosyl alcohol is $>$ that of a film of either component. Stearic acid is more permeable than its esters. The retardation of the evaporation of NH_3 from aq. NH_3 is not parallel with that of H_2O . The effect of eicosoic acid films in retarding the evaporation of 5% aq. EtOH appears to be selective, and differences are caused by the nature of the solvent used to spread the film; these differences decrease in course of time and are presumably due to the imprisonment of traces of solvent. F. L. U.

Insect cuticle as an asymmetrical membrane.—See A., 1941, III, 468.

Size distribution of particulate materials.—See B., 1941, I, 251.

Suspensions of solids in mixed liquids. E. W. J. Mardles (*Trans. Faraday Soc.*, 1941, **37**, 321—327; cf. A., 1941, I, 40).—Sediment vols. of kaolin, mica, SiO_2 , and Al powder in binary and ternary liquid mixtures have been measured as a function of composition. Addition of a small amount of adsorbable sol. substances (oleic acid, fish glue, cellulose acetate) decreases the sediment vol. Viscosity measurements indicate a general parallelism between η and sediment vol., high vals. of which are associated with flocculation of the particles. The rate of settling of various powders was also examined; the behaviour is largely governed by the degree of flocculation and by the shape of the particles. F. L. U.

Importance of dialysis in the study of colloids. VII. Colloidal zinc ferrocyanide. V. C. Vora, P. M. Barve, and B. N. Desai (*Proc. Indian Acad. Sci.*, 1941, **13**, A, 100—107).—With the progress of dialysis of colloidal $\text{Zn}_2\text{Fe}(\text{CN})_6$ the cataphoretic speed first increases and then decreases while the stability and conductivity decrease continuously. In the case of sols dialysed for periods shorter than the max. in the cataphoretic speed-dialysis curve the speed first increases and then decreases on dilution, whilst for sols dialysed for longer periods the speed decreases continuously. Stability and conductivity decrease continuously on dilution in all cases. With sols dialysed for a short time the cataphoretic speed first increases and then decreases on adding small increasing amounts of KCl, K_2SO_4 , $\text{K}_4\text{Fe}(\text{CN})_6$, MgCl_2 , and MgSO_4 ; with sols dialysed for longer times the speed decreases continuously with all the electrolytes except $\text{K}_4\text{Fe}(\text{CN})_6$, with which it first increases and then decreases. The idea of crit. potential is not supported. Cataphoretic speed, stability, and conductivity decrease continuously when sols, whatever the period of dialysis, are aged or exposed to sunlight. H. W.

Viscosity of cellulose and its nitrate in dilute solution. S. M. Neale and R. Waite (*Trans. Faraday Soc.*, 1941, **37**, 261—271).—Determination of the η of solutions of the same sample of cotton cellulose in cuprammonium hydroxide solvents of different compositions, at concns. up to 0.6 g. per 100 c.c., lead to limiting vals. ($c = 0$) of η_{sp} , that vary with the solvent. Neither $\log \eta$ nor η_{sp} is \propto the concn. In all but the most dil. solutions η varies with the rate of shear. Similar results are obtained when the same sample of cotton is nitrated and the nitrate dissolved in various org. solvents. The degree of polymerisation, both for the cellulose and for its nitrate, corresponds with 2000—3000 glucose units when

calc. by the method of Kraemer and Lansing (cf. A., 1935, 688). F. L. U.

Surface characteristics of cotton fibres as indicated by electrophoresis.—See B., 1941, II, 216.

Base-combining capacity of cotton.—See B., 1941, II, 216.

New views and results on coagulating effect of electrolytes on hydrophobic colloids. Wo. Ostwald (*J. Hung. Chem. Soc.*, 1941, 2, No. 1, 1—9).—A lecture containing a historical review of coagulation theories and an account of the author's theory. E. A.

Cataphoretic speed of sol particles as dependent on the redox potential of the liquid medium. J. C. Ghosh and N. G. Basak (*J. Indian Chem. Soc.*, 1940, **17**, 721—729).—The mobilities (A) of colloidal Au and Pt particles in very dil. aq. solutions of redox dyes have been determined, the electron activity being varied by reducing the dyes to different extents with H_2 and Pt-black or with $\text{N}_2\text{H}_4 \cdot \text{H}_2\text{O}$, and the p_H being varied by the addition of aq. NH_3 or AcOH. The results indicate that the change in A and hence in the electrokinetic potential is probably due not to any sp. ionic adsorption but to more general factors, particularly the electron activity of the medium responsible for the redox potential of the system. J. W. S.

VI.—KINETIC THEORY. THERMODYNAMICS.

Ethane-ethylene-hydrogen equilibrium. E. A. Guggenheim (*Trans. Faraday Soc.*, 1941, **37**, 271—273).—Revision of the calculations recently published (A., 1941, I, 113) results in a decrease of 4% in the calc. vals. of K_p in the range 673—973° K. F. L. U.

Colour phenomena associated with quinquivalent molybdenum solutions. II. Effect of various electrolytes. C. F. Hiskey and V. W. Meloche (*J. Amer. Chem. Soc.*, 1941, **63**, 964—969).—The influence of MgCl_2 , LiCl, NaCl, and KCl in 2M-HCl; LiCl in 0.2M-HCl; HBr; MgBr_2 in 2M-HBr; and H_2SO_4 ($> 8.0M$) in 3.5, 2.5, 1.5, 1.0, 0.5, and 0.1M-HCl on the transition of Mo^V from the colourless to amber forms (A., 1940, I, 369) has been investigated. The results depend on the dehydrating effect produced by $[\text{H}^+]$ and on the tendency of an added solvent to unite with H_2O of the system by means of dipole-dipole interactions. W. R. A.

Electric polarisation of carboxylic acids in dilute solutions of non-polar solvents. I. Relation of electric polarisation to association of carboxylic acids in hydrocarbon solvents. H. A. Pohl, M. E. Hobbs, and P. M. Gross. II. Polarisation of heavy acetic acid and of the three fluorobenzoic acids in benzene and the anomalous polarisation of the dimeride. A. A. Maryott, M. E. Hobbs, and P. M. Gross (*J. Chem. Physics*, 1941, **9**, 408—414, 415—418).—I. The electric polarisations of very dil. solutions of AcOH, HCO_2H , EtCO_2H , PrCO_2H , $\text{Bu}^n\text{CO}_2\text{H}$, $\text{CH}_3\text{Cl-CO}_2\text{H}$ (I), and BzOH in C_6H_6 and C_7H_{16} have been determined in order to study the association and polar character of these acids. The graph of mol. polarisation against mol. fraction shows a decided curvature, which can be explained by supposing that in dil. solution there exists a mixture of highly polar single mols. and slightly polar or non-polar double mols. With increase of concn. of acid, association of single to double mols. occurs, producing a less polar mixture. The polarisations of the single mols. [except (I)] are fairly const., in agreement with the fact that the moment is due to the CO_2H group. There is a rather large and substantially const. val. of the polarisation, $P_{D(A+O)}$, for all the dimeric mols. examined [except (I)]. The origin of this is considered to be an at. type of polarisation. AcOH and HCO_2H have considerably lower dissociation consts. in C_7H_{16} than in C_6H_6 , indicating that the unsaturated and highly anisotropic C_6H_6 mol. is a much better dissociating solvent.

II. The electric polarisation of AcOD, *o*-, *m*-, and *p*- $\text{C}_6\text{H}_4\text{F-CO}_2\text{H}$ has been determined in C_6H_6 solution, at concns. of 10^{-5} to 10^{-2} mol. fraction of solute. The high polarisation of dimeric mols. is discussed. It can only be satisfactorily explained as an at. polarisation term. There is very little difference in the P_S and P_D of heavy and light AcOH. The equilibrium const. of *o*- $\text{C}_6\text{H}_4\text{F-CO}_2\text{H}$ (4.7×10^{-4}) is considerably $>$ that of the other isomerides ($\sim 0.6 \times 10^{-4}$). This is probably due to a stabilisation of the mol. through H bond formation with the adjacent F atom. A. J. M.

Formation of ions from compounds with conjugated double bonds: hydrocarbon salts.—See A., 1941, II, 190.

Dissociation constants of the methylammonium ions and the basic strengths of the methylamines in water. D. H. Everett and W. F. K. Wynne-Jones (*Proc. Roy. Soc.*, 1941, A, 177, 499—516).—The dissociation consts. of the three substituted methylammonium ions were determined in aq. solution at 10° intervals from 0° to 50°. Vals. of the free energy, heat and entropy of dissociation are tabulated. The heat capacity changes are discussed and it is shown that they cannot be interpreted by simple electrostatic theory. The anomalous order of the basic strengths of the amines probably disappears at low temp. G. D. P.

Theory of acid strength. Temperature effect. J. I. Magee, T. Ri, and H. Eyring (*J. Chem. Physics*, 1941, 9, 419—427).—The dissociation consts. (K) of certain acids and bases pass through a max. in the neighbourhood of room temp. Thermodynamic treatment leads to the following equation connecting K , K_{\max} , the temp. θ at which K is a max., and the temp. T : $\log K - \log K_{\max} = p(T - \theta^2) + q(T - \theta)^2 + \dots$. The consts. p and q are evaluated, and for acids in aq. solution they are almost completely determined by the properties of H_2O , particularly the temp. variation of the dielectric const. The mechanism of dissociation is discussed. The dissociation of H_2O can be represented by $(m + n + 2)H_2O \rightleftharpoons H_3O^+(mH_2O) + OH^-(nH_2O)$, the m mols. of H_2O being "frozen" to the H_3O^+ and n to OH^- ; $m + n + 2 \approx 16$. This is in agreement with the work of Harned *et al.* on H_2O -dioxan mixtures (A., 1939, I, 565). A. J. M.

Activity coefficient of hydriodic acid at 25° from isopiestic vapour-pressure measurements. H. S. Harned and R. A. Robinson (*Trans. Faraday Soc.*, 1941, 37, 302—307).—Data for the osmotic and activity coeffs. of HI over the range 0.05—3.0M. are tabulated. The $\log \gamma - \sqrt{m}$ curve is higher than any yet obtained for 1—1 electrolytes. The results are fitted to two extended forms of the Debye-Hückel equation and, using published e.m.f. data, the normal potential E° of the $Ag|AgI$ electrode is calc. to be 0.1517 v. The free energy changes of some H—I reactions are discussed and $E^\circ = 0.5352$ v. is computed for the $I_2|I^-$ electrode. F. L. U.

Solutions of long-chain compounds. M. L. Huggins (*J. Chem. Physics*, 1941, 9, 440).—The method of Fowler *et al.* (A., 1937, I, 513) for deriving statistically equations for the activities of the constituents of a dil. binary solution, in which the solute mols. are elongated and occupy twice the vol. of a single solvent mol. and there is no heat of mixing, has been extended to a dil. solutions of long-chain mols. each made up of randomly oriented "sub-mols." similar in nature and size to one of the solvent mols. The application of the equation to osmotic pressure is given. A. J. M.

Equilibrium conditions in two-phase multi-component systems. I. A. Storonkin (*Acta Physicochim. U.R.S.S.*, 1940, 13, 505—530).—The general conditions for equilibrium in a two-phase system of n components are expressed in differential equations, and certain known regularities are deduced as special cases. F. J. G.

Liquid-vapour equilibrium relations in binary systems. n -Butane- n -heptane system. W. B. Kay (*Ind. Eng. Chem.*, 1941, 33, 590—594; cf. A., 1938, I, 241).—Pressure-temp. curves up to the crit. points and d of liquid and vapour have been determined for mixtures of n - C_4H_{10} and n - C_7H_{16} . The max. crit. pressure is 596 lb. per sq. in. at 77 mol.-% of C_4H_{10} . With rising temp. and pressure the vapour/liquid concn. ratios of C_4H_{10} dissolved in C_7H_{16} , and of C_7H_{16} dissolved in C_4H_{10} , deviate from those calc. from the fugacities until at the crit. point the ideal solution laws are quite inapplicable. A. R. Pe.

Energy of formation and solubility of ferrous sulphide. W. D. Treadwell and O. Gübeli (*Helv. Chim. Acta*, 1941, 24, 137—148).—The equilibrium $FeS + H_2 \rightleftharpoons Fe + H_2S$ has been studied at 250—700° by the circulation method. The heat of reaction is calc. to be 18,050 g.-cal. per g.-mol., the difference between this val. and that calc. from literature vals. of the heat of formation of FeS ($\sim 18,490$ g.-cal. per g.-mol.) being attributed to the heat of transition of Fe at 298°. From the equilibrium data and published val. of the Fe electrode potential, the solubility const. $[Fe^{2+}][H_2S]/[H^+]^2$ of the thermally produced FeS is calc. to be 1.35×10^2 and $0.95 \times$

10^2 at 25° for the high- and low-temp. forms, respectively, whereas the observed val. for pptd. FeS is 2.8×10^3 . This high val. is attributed to diminution of the lattice energy of the pptd. material through inclusion of foreign ions and H_2O of hydration. The val. of the entropy changes of the reaction calc. from these results can be reconciled with the val. calc. from the entropy vals. of the reactants if Cross' val. of the entropy of H_2S (A., 1935, 569) is changed from 49.15 to 48.25 entropy units. J. W. S.

M.p. of binary mixtures of oleic, linoleic, and linolenic acids. H. W. Stewart and D. H. Wheeler (*Oil and Soap*, 1941, 18, 69—71).—The m.p. (by capillary-tube method) curve of mixtures of pure oleic acid (I) (prepared from Me oleate; cf. Wheeler and Riemenschneider, B., 1940, 222) and linoleic acid (II) affords no evidence of compound formation, but shows eutectics at 75.2 mol.-% of (II) at -10.0° for the α - and 76.3 mol.-% for the β -form of (I) at -9.8° . Similarly, the graphs for the system (I)—linolenic acid (III) show eutectics at 82.7 mol.-% of (III) at -15.7° for α - and 85.5 mol.-% at -15.1° for β -oleic acid. The appearance of the β -form of (I) and the consequent double m.p. is observed on the (I) side of the eutectics only (cf. Smith, A., 1939, II, 356) in mixtures containing $>50\%$ of (II) or (III). Mixtures of (II) and (III) give m.p. between those of the pure acids, the curve showing neither eutectic nor evidence of compound formation. E. L.

Intermolecular compounds. H. M. Haendler and L. W. Rising (*J. Amer. Pharm. Assoc.*, 1941, 30, 105—107).—Tabulated data for "thaw point" and m.p. of various mixtures of $NHPhAc$ -antipyrine (I), -mandelic acid (II), $-\beta$ - $C_{10}H_7$ -OH (III), -phenacetin (IV), -pyrimidone, -sulphonal (V), and -trional, (IV)-(I), -(II), and -(III), and (II)-(III) and -(V) do not indicate the formation of a compound in any of these systems. F. O. H.

Alumina floe. Composition of floe formed at p_H values below 5.5. H. E. Weiser, W. O. Milligan, and W. R. Purcell (*Ind. Eng. Chem.*, 1941, 33, 669—672).—X-Ray radiograms of Al_2O_3 gels formed at $p_H < 5.5$ by adding $NaOH$ to $Al_2(SO_4)_3$ solutions show the presence of a cryst. phase differing from that of γ - $Al_2O_3 \cdot H_2O$ (I) which is formed at $p_H > 5.5$. The aged ppt. gives a pattern distinct from that for any recognised form of hydrated or anhyd. Al_2O_3 ; the dehydration isobar and analysis indicate the composition $Al_2O_3 \cdot SO_3 \cdot 1.5H_2O$. No other basic sulphate was indicated. Gels made from $Al(NO_3)_3$ and $AlCl_3$ at $p_H 4$ had composition (I); no basic nitrates or chlorides were formed. Breaks in the potentiometric titration curves of the Al salts with $NaOH$ do not establish the presence of basic salts. S. M.

Ammonia-soda process under high pressures of carbon dioxide. Identification of solid phases. Phase diagrams.—See B., 1941, I, 282.

Equilibria of liquid iron and slags of the system CaO - MgO - FeO - SiO_2 . K. L. Fettes and J. Chapman (*Amer. Inst. Min. Met. Eng.*, 1941, *Tech. Publ.* 1316, 13 pp.; *Met. Tech.*, 1941, 8, No. 2).—Slag mixtures consisting of CaO , MgO , SiO_2 , FeO , and Fe_2O_3 were maintained at a series of temp. in contact with pure Fe in MgO crucibles under N_2 until equilibrium was reached (for >30 min.), after which samples of slag and metal were taken for chemical analysis. The analytical results are tabulated. The $[O]$ of Fe in equilibrium with slag is a function of the temp. and both $[O]$ and $[S]$ vary with slag composition. The $[O]$ at 1600° , the distribution ratios between slag and metal for O and S at 1600° , the activity of the FeO in the slag, and the % remaining as Fe_2O_3 at 1600° are shown in ternary diagrams [the composition of the slag being expressed for simplicity as $(CaO + MgO)-FeO-SiO_2$]. The solubility of MgO in CaO - FeO - SiO_2 slags is also shown. Preliminary observations indicate that stable orthosilicates and monoferrites exist in the liquid slags. J. C. C.

Vapour pressure and vapour composition in liquid mixtures. V. Kireev (*Acta Physicochim. U.R.S.S.*, 1940, 13, 552—564).—The generalisation (cf. following abstract) that in a given mixture S_E and S_{IE} are respectively $\propto H_M$ and H_{IM} is used in the derivation of relations between v.p., vapour composition, and heat of mixing, for binary mixtures. The conditions for azeotropy are discussed. F. J. G.

Change of entropy and of free energy in the formation of liquid mixtures. V. Kireev (*Acta Physicochim. U.R.S.S.*,

1940, 13, 531—551).—Recorded v.p. and calorimetric data have been used in a computation of the entropies (S_M) and partial mol. entropies (S_{iM}) of mixing for a no. of binary liquid mixtures. For two systems, C_6H_6 - CCl_4 and CS_2 - Et_2O , the deviations (S_E and S_{iE}) of S_M and S_{iM} from the ideal vals. are very small, but in general S_E and S_{iE} , though relatively small, are too great to be neglected, since TS_E and TS_{iE} are comparable with H_M and H_{iM} , the total and partial mol. heats of mixing. In many systems S_E and S_{iE} are approx. $\propto H_M$ and H_{iM} respectively. The rule that an evolution of heat on mixing accompanies a negative departure from linearity of the v.p.-composition curve is not generally valid.

F. J. G.

Thermodynamic properties of phosphorus, phosphine, and some phosphorus halides. D. P. Stevenson and D. M. Yost (*J. Chem. Physics*, 1941, 9, 403—408).—The free energies, entropies, and heat contents of P and a no. of P compounds are calc. from equilibrium, mol., and thermal data. For P vapour, the equilibrium const. of the dissociation $P_2 \rightleftharpoons 2P$ is calc. from equilibrium and mol. data, and also from spectroscopic data, the latter being regarded as the more satisfactory. Dissociation of P_2 is very slight, even at 1200°. The entropy of white P is calc. The equilibrium consts. and ΔH_0 of the reactions $P_4 + 6H_2 \rightleftharpoons 4PH_3$ and $PCl_3 + Cl_2 \rightleftharpoons PCl_5$ have been calc. The free energies and heat contents of P, P_2 , P_4 , PH_3 , PF_3 , PCl_3 , PBr_3 , PCl_5 , $POCl_3$, and $PSCl_3$ at temp. from 298° to 1500° K. are given, and are intended to replace the vals. given by Anderson *et al.* (A., 1936, 1340). A. J. M.

Free energies of formation of gaseous hydrocarbons and related substances. C. M. Thacker, H. O. Folkins, and E. L. Miller (*Ind. Eng. Chem.*, 1941, 33, 584—590).—Equations are tabulated expressing as a function of temp. (a) the sp. heats in the gaseous state of the paraffins up to n - $C_{10}H_{22}$, the Δ^4 -olefines up to $C_{10}H_{20}$, H_2 , O_2 , CO, CO_2 , and H_2O , and of graphite, and (b) the free energies of formation of the above substances, of 29 branched-chain paraffins, of 23 other C_2H_4 derivatives, and of CS_2 , H_2S , NH_3 , SO_2 , and SO_3 . Standard free energies of formation calc. from these data at 100° intervals from 300° to 1200° K. are tabulated. The increase per CH_2 group of sp. heat in the paraffin series from C_3H_8 is expressed by $\Delta C_p = 0.51 + 0.13T$, T being abs. temp. Sp. heats of the Δ^4 -olefines were derived from those of the corresponding paraffins by extrapolating from the experimental ratios for the C_2 , C_3 , and C_4 members. The data for the branched chains are less accurate than the rest but with this qualification the tables can be used to predict changes of equilibrium with temp. (cf. Thomas *et al.*, A., 1938, I, 32).

A. R. PE.

VII.—ELECTROCHEMISTRY.

Hydrogen overvoltage at high current densities. III. Influence of oxygen. A. Hickling and F. W. Salt (*Trans. Faraday Soc.*, 1941, 37, 319—321).—Measurements of H overvoltage at amalgamated Cu electrodes show it to be unaffected by O_2 at c.d. ≤ 10 times the limiting current for O_2 diffusion to the cathode, and to be completely eliminated below a crit. c.d. which is higher for stirred and lower for unstirred solutions. For unstirred aq. solutions in air O_2 is without appreciable influence at c.d. ≤ 1 ma. per sq. cm., provided time is allowed for the diffusion layer to be built up.

F. L. U.

Decay of hydrogen overpotential at a mercury surface. S. C. Ganguli (*J. Indian Chem. Soc.*, 1940, 17, 691—698).—0.1N- Na_2SO_4 containing different concns. of maleic or fumaric acid has been electrolysed for various periods of time, and the decay in the potential of the Hg cathode after switching off the current studied. When the potential relative to a 0.1N- Hg_2Cl_2 electrode is 1.35—1.5 v. immediately after interrupting the current, the potential rises during the first few min. and then decays exponentially, whereas when the initial potential is outside these limits it begins to decay immediately, as in the absence of reducible material. The observations are in accord with the view that both the transference of an electron from the electrode to the hydrated H^+ ion and the combination of H atoms adsorbed on the electrode are slow processes with comparable velocities.

J. W. S.

Polarographic study of aliphatic nitro-compounds.—See A. 1941, II, 209.

VIII.—REACTIONS.

Thermal reaction between hydrogen and oxygen. III. Temperature coefficient of the steady thermal reaction. O. Oldenberg and H. S. Sommers, jun. (*J. Chem. Physics*, 1941, 9, 432—438).—The thermal combination of H_2 and O_2 has been investigated in various vessels (quartz, Pyrex, and Pyrex covered with KCl). The reaction follows the Arrhenius law over the temp. range considered (~ 490 — 570°). Addition of He had no effect on the rate of combination. It is concluded that in this temp. range the chains are not branched.

A. J. M.

Thermal explosion of the $2H_2 + O_2$ mixture. D. Frank-Kamenetzki (*Acta Physicochim. U.R.S.S.*, 1940, 13, 730—731).—The location of the third explosion limit of the $2H_2 + O_2$ mixture, reported by Oldenberg and Sommers (A., 1939, I, 325), was predicted by the author on theoretical grounds (cf. A., 1940, I, 259). The approx. agreement between theory and experiment indicates the thermal nature of this third limit.

F. L. U.

Limits of inflammability of butadiene in air. G. W. Jones and R. E. Kennedy (*U.S. Bur. Mines*, 1941, *Rept. Invest.* 3565, 4 pp.).—Tests made in a tube of sufficient diameter to minimise the cooling effect of the wall and long enough to ascertain whether flame propagation continues after the heating effect due to the ignition source is dissipated indicate that the lower and upper limits of inflammability of $(CH_2)_2CH_2$ in air at room temp. and pressure are 2.0 and 11.5 vol.-%, respectively.

J. W. S.

Kinetics of polymerisation of vinyl acetate in presence of benzoyl peroxide in benzene solution. S. Kamenskaja and S. Medvedev (*Acta Physicochim. U.R.S.S.*, 1940, 13, 565—586).—The polymerisation of $CH_3CH=OAc$ (I) in C_6H_6 solution at 50—85° in presence of Bz_2O_2 (II) has been studied. Under these conditions the thermal reaction is negligible, and the process is completely homogeneous. (II) in C_6H_6 solution undergoes a unimol. decomp. with $E = 29.6$ kg.-cal. During the polymerisation of (I) the disappearance of (II) is still unimol. but is more rapid and does not follow the Arrhenius equation. The kinetics of the polymerisation accord with a chain mechanism in which a complex of (I) and (II) reacts with (I) to give free radicals; $E = 25.5$ kg.-cal. The mean chain length and the mean degree of polymerisation are not sybatic. This is accounted for by "chain transfer": a polymeride radical may take a H atom from some mol. species (reactant or solvent), so stabilising itself, while the resultant free radical starts another chain.

F. J. G.

Kinetics of action of trypsin on synthetic substrates.—See A., 1941, III, 534.

Kinetics of proteinase action. Application to specificity problems.—See A., 1941, II, 534.

Dependence of the laws of size distribution of crystals on kinetics of crystallisation. II. Laws of crystallisation with decreasing concentration in the homogeneous phase. O. M. Todes (*Acta Physicochim. U.R.S.S.*, 1940, 13, 617—638; cf. A., 1941, I, 81).—Mathematical. Expressions are derived for the rate of crystallisation; max. size, and size distribution for the case where the probability of the occurrence of crystallisation centres, as well as the rate of linear growth, depends on the concn. of the homogeneous crystallising phase. The combination of these conditions with the initial presence of crystallisation centres is also treated.

F. L. U.

Sensitised explosions. V. Hydrogen-oxygen reaction sensitised by nitrogen peroxide. VI. Hydrogen-oxygen reaction sensitised by nitrosyl chloride. VII. A chain-thermal theory of the reaction between hydrogen and oxygen sensitised by nitrogen peroxide or nitrosyl chloride. F. S. Dainton and R. G. W. Norrish (*Proc. Roy. Soc.*, 1941, A, 177, 393—410, 411—420, 421—447; cf. A., 1939, I, 528).—V. The effect of pressure and temp. of reactants, of inert gases, of vessel diameter, and of surface condition on the induction periods and explosion boundary of $2H_2O + O_2$ mixtures containing NO_2 has been determined in the range 350—410°. At any given pressure of the reactants there are two concns. of NO_2 which mark the upper and lower limits of the explosion region; at a given concn. of sensitiser there are two pressures of reactants enclosing the ignition region. The induction periods of mixtures of const. $[NO_2]$ decrease rapidly with increase of

pressure. All foreign gases lengthen the induction periods and eventually quench the ignition of an explosive mixture. The efficiency of gases in lengthening the induction period is $\text{CO}_2 > \text{N}_2 > \text{A} = \text{He}$; the efficiency in quenching ignition is $\text{CO}_2 > \text{He} > \text{N}_2 > \text{A}$. The induction period at the upper limit is $>$ at the lower limit. At const. total pressure the upper limit P_0 varies with temp. according to the equation $\log P_0 = -E/RT + \text{const.}$; the upper limit decreases and the lower increases as the reciprocal of the square of the diameter of the reaction vessel.

VI. The induction periods and limits depend on pressure and temp. in a very similar way to those in the system $\text{H}_2\text{O}_2\text{--NO}_2$ (cf. Part V, above). Inert gases quench the ignition but shorten the induction periods.

VII. Both the above reactions are chain processes for which the net branching factor ϕ is inversely \propto to the induction period. Ignition occurs only when ϕ attains a val. determined by the sum of two quantities, one \propto thermal capacity and the other \propto thermal conductivity. Ignition is visualised as occurring only when the initial reaction rate in a favourable vol. element is large enough to ensure a crit. temp. T_c being reached in a crit. time t_c . The theory accounts satisfactorily for the experimental data. G. D. P.

Autocatalytic character of the decomposition of the hypochlorite ion. J. M. González Barredo (*Anal. Fis. Quím.*, 1941, 37, 123—157).—Application of the author's method (A., 1936, 1074) to a kinetic study of the decomp. of NaOCl solutions at const. p_{H} shows that Cl^- autocatalyses the reaction to an extent which increases with the concn. of Cl^- . The catalytic effect of NO_3^- is \ll of Cl^- . F. R. G.

Theory of the formation of catalytically active ensembles on surfaces. IV. Application of the theory to catalyst-poisoning. N. I. Kobosev (*Acta Physicochim. U.R.S.S.*, 1940, 13, 469—504).—The phenomena of poisoning are discussed in the light of the theory (A., 1939, I, 271) that catalytically-active groupings of atoms are distributed statistically among migration regions which are thermodynamically isolated from one another. It is shown that the probability (β) that a mol. of poison entering a region containing an active group shall become adsorbed on that group, and so deactivate it, will in general be ~ 1 . For $\beta = 1$, the residual activity will be $A = A_0 e^{-g/Z_0}$, where g is the total quantity of adsorbed poison and Z_0 the no. of individual migration regions. For $\beta < 1$, a more complicated expression is obtained, indicating a linear dependence of A on g/Z_0 in the early stages of poisoning. It is deduced that the course of the poisoning will be independent of the nature of the reaction and of the poison, and the relative activity A/A_0 independent of temp., in agreement with observation. Results taken from literature are discussed, and vals. of Z_0 , and hence of r_{z_0} , the activity per migration region, are obtained for the various catalysts, and compared. The individual migration regions are found to be very small (~ 10 atoms); the effect of a carrier is usually to increase Z_0 , and this both increases the activity and diminishes the susceptibility to poisoning; in some cases carriers also increase r_{z_0} . F. J. G.

Correlation between adsorption of hydrogen and activity of catalysts containing copper oxides. B. R. Stanerson (*Iowa State Coll. J. Sci.*, 1940, 15, 104—106).— Cu_2O , prepared by reducing $\text{Cu}(\text{NO}_3)_2$ with glucose, adsorbed H_2 so that equilibrium was reached in ~ 2 hr. at 57° and more rapidly at higher temp. Only ~ 0.2 of the H_2 adsorbed was freed when the pressure was reduced from 52.27 to 2.81 cm. of H_2O . Promoters of H_2 adsorption were active in the following descending order of efficiency: BaO , $\text{CaO} + \text{V}_2\text{O}_5$, CaO , SrO , MgO . There is an approx. parallelism between the adsorptive power of the catalysts and their ability to reduce furfuraldehyde at 222° and 600 lb. pressure. J. L. D.

Properties of activated sugar charcoal coated with various organic substances. III. Catalytic decomposition of hydrogen peroxide. H. K. Acharya (*J. Indian Chem. Soc.*, 1941, 18, 15—18; cf. A., 1937, I, 457).—Coats of palmitic acid and $\alpha\text{-C}_{10}\text{H}_{17}\text{NH}_2$ on activated sugar-C (0.01 g. per g. of C) increase the catalytic decomp. of H_2O_2 by the C. In both cases decomp. follows a unimol. reaction rate and is independent of p_{H} , as has been found for uncoated C. C. R. H.

Formation of propylene by [catalytic] dehydrogenation of propane.—See B., 1941, II, 209.

[Catalytic] preparation of ethylbenzene from naphthalene.—See B., 1941, II, 209.

Ruthenium catalysts for synthesis of hydrocarbons of high mol. wt.—See B., 1941, I, 274.

[Catalytic] synthesis of benzene from carbon monoxide and hydrogen.—See B., 1941, I, 272.

[Catalytic] hydrogenation of anthracene and carbazole.—See B., 1941, II, 210.

[Catalytic] dehydration of α -butylene glycol.—See B., 1941, II, 209.

Chemical action of electrical discharges. XXI. Variation of the yield of hydrogen cyanide produced by means of the high-frequency arc with the molecular size of the hydrocarbon. E. Briner and H. Moefler (*Helv. Chim. Acta*, 1941, 24, 188—190; cf. A., 1941, I, 53).—The yield of HCN obtained on passage of a mixture of hydrocarbon vapour and N_2 through a high-frequency arc varies only slightly with the mol. wt. of the hydrocarbon between C_8H_{18} and $\text{C}_{12}\text{H}_{22}$. A slight tendency for it to decrease beyond $\text{C}_{10}\text{H}_{22}$ is attributable to the necessity of diminishing the hydrocarbon concn. to reduce carbonisation. It is inferred that petroleum fractions covering a fairly wide b.p. range ($100\text{--}200^\circ$) can be used to obtain high yields of HCN in the high-frequency arc. J. W. S.

Chemical syntheses by means of electric discharges and the improvement of their yields. E. Briner (*Arch. Sci. phys. nat.*, 1941, [v], 23, 25—56).—Chemical syntheses which can be carried out by passing gaseous mixtures over an electric arc are discussed. The author's investigations on the synthesis of NO are described, with particular reference to the study of the effects of adding metals of low ionisation potential to the Cu electrodes, and the effects of pressure, frequency, and the composition of the gaseous mixture used. The application of these results in the production of high yields of NO is discussed. J. W. S.

Polymerisation processes induced by mitogenetic radiation. II. Influence on amino-acids and production of a "deaminase" by irradiation. A. Gurvitsch and L. Gurvitsch (*Acta Physicochim. U.R.S.S.*, 1940, 13, 690—696; cf. A., 1939, I, 620).—The term "deaminase" is used to indicate the mode of action rather than the chemical nature of a substance (I) of high mol. wt. that is formed during the irradiation of aq. glycine. The probable sequence of reactions leading to the formation of (I) is discussed. This formation follows, but is not dependent on, the primary dissociation of the glycine mol., which is confined to the fission of OH. The presence of O_2 , though essential to the production of NH_3 by the action of (I) on glycine, is not needed for the formation of (I). The energy of polymerisation of the active monomers that constitute the units of (I) amounts to 71—76 kg.-cal., and may be available for the activation of the deamination process. F. L. U.

IX.—METHODS OF PREPARATION.

Reduction of magnesium oxide by tungsten in vacuum. G. E. Moore (*J. Chem. Physics*, 1941, 9, 427—431).—Some chemical reactions which seem improbable under normal conditions proceed at an appreciable rate in vac., e.g., in radio valves. Thus, under these conditions, W will reduce MgO to Mg. The free energy of the reaction $2\text{MgO} + \text{W} = 2\text{Mg} + \text{WO}_2$ and the velocity of the reaction in vac. have been calc.; it is possible from energy considerations for the reaction to occur under the conditions prevailing in a radio valve. A. J. M.

Composition of "5 : 3" calcium aluminate. T. Thorvaldson and W. G. Schneider (*Canad. J. Res.*, 1941, 19, B, 109—115).—On thermal decomp. of pure isotropic $3\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{H}_2\text{O}$, 26.6% of CaO is liberated, and the product gives an X-ray pattern identical with that of "5 : 3" Ca aluminate. The composition of the latter is therefore $12\text{CaO} \cdot 7\text{Al}_2\text{O}_3$. F. J. G.

Dehydration of tricalcium aluminate hexahydrate. W. G. Schneider and T. Thorvaldson (*Canad. J. Res.*, 1941, 19, B, 123—128).—When $3\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{H}_2\text{O}$ (I) is heated in a current of dry air at $275\text{--}375^\circ$ $3\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot 1.5\text{H}_2\text{O}$ (II), $n = 1.543 \pm 0.003$, is formed. (II) is stable at $< 275^\circ$ and from 275° to 300° decomp. is very slow, CaO being liberated. At $> 350^\circ$ decomp. is rapid, and $12\text{CaO} \cdot 7\text{Al}_2\text{O}_3$ is formed at 500° .

When (I) is heated in N_2 the behaviour is similar. The system (I)–(II) is an effective dehydrating agent at $>100^\circ$.

C. R. H.

Action of iodates on hypophosphoric acid. W. Jung (*Anal. Asoc. Quim. Argentina*, 1941, 29, 15–32).— $Na_2H_2P_2O_6$ is stable to KIO_3 in alkaline or neutral solution. The rate of oxidation by 0.1M- KIO_3 in 10N- H_2SO_4 is identical with the rate of hydrolysis by 10N- H_2SO_4 , hence the oxidation of $H_4P_2O_6$ in acid is preceded by its hydrolysis to H_3PO_3 and H_3PO_4 , the former then being oxidised to H_3PO_4 . F. R. G.

Formation of pentathionic acid. R. A. Crespi Gherzi (*Rev. Fac. Cienc. Quim., La Plata*, 1940, 15, 13–17).—Contrary to certain authors, powdered S with H_2O does not give $H_2S_5O_6$. $H_2S_5O_6$ can be determined colorimetrically by 5% $AgNO_3$ and 2N. aq. NH_3 in presence of $H_2S_3O_6$ or H_2SO_3 . F. R. G.

Double salt of potassium tricyanomanganate and potassium hexacyanomanganate. W. D. Treadwell, O. Gübeli, and D. Huber (*Helv. Chim. Acta*, 1941, 24, 152–157).—When a solution of $MnSO_4$ (0.05 mol.) in aq. KCN (1.5 mols.) is reduced electrolytically, and then titrated potentiometrically, using a short Pt wire electrode, potential jumps are observed corresponding with the complete oxidation of Mn^{II} to Mn^{III} and of Mn^{III} to Mn^{IV} , respectively. Such titrations on the mother-liquor and on the ppt. produced after various periods of reduction indicate that the white ppt. formed during the electrolytic reduction is the compound $K_2Mn(CN)_3 \cdot K_4Mn(CN)_6$, and not $K_2Mn(CN)_3$ as stated by Grube and Brause (A., 1928, 29). J. W. S.

Applications of radioactive indicators for solution of certain problems of the chemistry of complex compounds. A. A. Grinberg (*Bull. Acad. Sci. U.R.S.S., Ser. Phys.*, 1940, 4, 342–349).—The Br atoms of the complex salts $K_2[PtBr_6]$, $K_4[PtBr_6]$, and $[Pt(NH_3)_2Br_2]$ are very labile, and are readily replaced by *Br (prepared by bombardment with neutrons from a cyclotron source). On this evidence all six Br of $[PtBr_6]^{4-}$ are functionally equiv. Exchange of Ir or Pt does not take place between stable complexes, such as $K_2[PtCl_6]$ and $[Pt(NH_3)_2Cl_4]$, $(NH_4)_2[IrCl_6]$ and $[Ir(C_2H_5N)_2Cl_4]$, or $(NH_4)_3[IrCl_6]$ and $H[Ir(C_2H_5N)_2Cl_4]$, using *Ir and *Pt as indicators. The activity of *Ir is several hundred times that of *Pt , and a method of determination of traces of Ir in Pt might be based on this difference. R. T.

X.—ANALYSIS.

Determination of hydrogen in ferrous materials by vacuum extraction at 800° and by vacuum fusion.—See B., 1941, I, 295.

Potentiometric determination of chlorides in presence of bromides. M. Galar (*Rev. Fac. Cienc. Quim., La Plata*, 1940, 15, 279–287).— Br^- is oxidised by Berg's method (A., 1927, 35) carried out in 2.5N- H_2SO_4 , and Cl^- determined potentiometrically by Vanossi's method (A., 1938, I, 47). McAlpine's method (A., 1929, 782) is not suitable for potentiometric determination. F. R. G.

Investigation of halogen acids following elimination of thiocyanic acid. J. F. Salellas (*Rev. Fac. Cienc. Quim., La Plata*, 1940, 15, 99–106).—Small quantities of halogen ions can be identified in presence of each other and CNS^- by destruction of the latter with 3% $KMnO_4$ and 2N- Na_2CO_3 ; excess of $KMnO_4$ is removed with H_2O_2 . I^- is identified in the original test solution by oxidation with H_2O_2 and dil. HNO_3 followed by agitation with $CHCl_3$. Br^- is identified in the CNS^- -free portion by addition of HCl , Cl_2 , H_2O , and $CHCl_3$, when a yellow colour precedes the formation of the violet due to I . If I^- and Br^- are absent, Cl^- can be identified in the hot CNS^- -free solution by addition of $AgNO_3$; the pptn. must not be carried out in the cold owing to the presence of SO_4^{2-} resulting from the oxidation. To identify Cl^- if I^- and/or Br^- are present with the CNS^- , the solution with 25% HNO_3 and a slight excess of $KMnO_4$ is boiled, excess of the latter removed with KNO_3 , IO_3^- removed by 10% $Pb(NO_3)_2$, and the Cl^- pptd. as before. The sensitivities of the tests are recorded for a no. of mixtures; in general 0.5 mg. of halogen ion can be identified in presence of 100 mg. of CNS^- in 10 c.c. of solution. F. R. G.

Determination of chlorine in water.—See B., 1941, III, 190.

Determination of combined nitrogen in metallic aluminium by the Kjeldahl method.—See B., 1941, I, 297.

Indicators for determination of combined nitrogen in iron and steel.—See B., 1941, I, 294.

Micro-determination of potassium.—See A., 1941, III, 636.

Electrolytic determination of lead as peroxide. D. N. Solanki and T. V. Subbarao (*J. Indian Chem. Soc.*, 1941, 18, 45–46).—The optimum conditions for the anodic deposition of pure PbO_2 are 3.0–3.1 v., 3 amp., 50–60°, 30 min., Pt gauze anode, and rotating Pt spiral cathode.

C. R. H.

Chemical analysis by X-rays. III. Appropriate voltages for determination by direct comparison. L. Rivoir and J. M. González Barredo (*Anal. Fis. Quim.*, 1941, 37, 48–53).—Intensities of the $K\alpha$ line are compared for Cu and Zn for 8–44 kv. F. R. G.

Determination of mercury and copper. S. J. Das-Gupta (*J. Indian Chem. Soc.*, 1941, 18, 43–44).—The reagent is prepared by dissolving 0.11 g. of 2-chloro-5-thiol-7-methoxy-acridine in 100–150 c.c. of EtOH with the addition of 3.5 c.c. of 0.1N-NaOH and filtering. When added in excess to neutral Hg^{II} (10–20 mg. of Hg) or Cu^{II} (5–10 mg. of Cu) solutions a ppt. is formed which is washed with EtOH and dried at 100° . 1 g. of ppt. = 0.2676 g. Hg or 0.09286 g. Cu. The reagent should be freshly prepared and other metals of groups 1, II, and III should be absent. C. R. H.

Investigation of the ferric ion by means of thiocyanate. R. Vanossi (*Anal. Asoc. Quim. Argentina*, 1941, 29, 48–74).—Methods for the identification of Fe^{+++} are surveyed. Procedure is described for micro- and semimicro-identification of Fe^{+++} in which the thiocyanate complex is extracted with EtOAc. F. R. G.

Determination of indium. A. T. Nishnik (*Ber. Inst. Chem. Akad. Wiss. Ukrain.*, 1940, 6, 265–289).—Sn and Sb cannot be separated from In as sulphides or by HNO_3 , but Sn_2S_3 and Sb_2S_3 are quantitatively dissolved by shaking with dil. colourless $(NH_4)_2S$, leaving pure In_2S_3 . $In(OH)_3$ is quantitatively pptd. by 6N. aq. NH_3 at 60° , which dissolves $Zn(OH)_2$, $Cd(OH)_2$, $Cu(OH)_2$, etc. Freshly pptd. $In(OH)_3$ is readily sol. in an excess of NH_4 salts. In concentrates are dissolved in HCl and treated with hot dil. aq. NH_3 . The ppt. is dissolved in hot dil. H_2SO_4 to eliminate Pb. The filtrate is pptd. by hot dil. aq. NH_3 , dissolved in HCl, again pptd. by NH_3 , and immediately redissolved by AcOH. The solution is treated with H_2S at 80° , and Sn_2S_3 and Sb_2S_3 are extracted from the ppt. by $(NH_4)_2S$. J. J. B.

XI.—APPARATUS ETC.

Characteristics of hollow-cathode discharge tubes. C. C. Van Voorhis and A. G. Shenstone (*Rev. Sci. Instr.*, 1941, 12, 257–261).—The characteristic effects of the inert gas, and of variations in the dimensions of the cathode, on the min. pressure at which the Schuler discharge may be started and maintained have been examined. A. A. E.

Time lags in coincident discharges of Geiger-Müller counters. M. E. Rose and W. E. Ramsey (*Physical Rev.*, 1941, [ii], 59, 616–617).—An investigation, by a special counter arrangement, of the abnormally low efficiency of O_2 -filled counters (cf. A., 1936, 919) is reported. Results support quant. considerations that the anomaly is due to time lags, resulting from electron capture, between the passage of the ray through the counter and initiation of the discharge (cf. A., 1939, I, 594). N. M. B.

High-speed electronic counter. Anon. (*J. Sci. Instr.*, 1941, 18, 117).—The counter, which employs several gas-filled triodes and their associated relays, is claimed to count at any speed between 0 and 2000 impulses per min. and to follow any variations in the speed of counting. A. A. E.

Ionisation chamber for counting alpha-particles. W. D. Urry (*Rev. Sci. Instr.*, 1941, 12, 289–290).—The chamber is designed to permit rapid interchange of sources and to reduce exposure to the atm. to a min. It has been used to determine the rate of emission of α -particles from sources containing the isotopes of U or Th, and from Ra sources. A. A. E.

Use of the polarograph for analysis of meat-curing brines.—See B., 1941, III, 181.

Apparatus for volumetric gas analysis. M. Shepherd (*J. Res. Nat. Bur. Stand.*, 1941, 26, 351—356).—Apparatus previously described (A., 1931, 457) is improved. O. D. S.

Apparatus for the absorption or gravimetric determination of constituents of a gas mixture. M. Shepherd and H. W. Bailey (*J. Res. Nat. Bur. Stand.*, 1941, 26, 347—349).—A convenient form of absorption train is described. O. D. S.

Manometric gas analysis apparatus. M. Shepherd and E. O. Sperling (*J. Res. Nat. Bur. Stand.*, 1941, 26, 341—346).—A modified form of the Van Slyke apparatus with separate vessels for absorption and measurement of the gas is described. O. D. S.

Ring method for determination of interfacial tension. H. H. Zuidema and G. W. Waters (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 312—313).—Mathematical analysis of the tabulated data of Harkins and Jordan (A., 1930, 852) of factors used for surface-tension work gives the relation $(F - a)^2 = (4b/\pi^2 R^3)[P/(D - d)] + C$, where $F = S/P$ = correction factor, S = interfacial tension, P = max. pull on ring, D and d are d of the lower and upper phases, R = radius of ring, and C is a const. depending on the ratio r/R , where r is the radius of the wire of the ring, and a and b are universal consts. Use of this equation in the ring method gives results in excellent agreement with those obtained by the capillary method. J. D. R.

Micro-determination of mol. wt. of dark-coloured organic materials. Cryoscopic method. V. A. Aluise (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 365—367).—The difficulty of observing the f.p. of dark solutions is overcome by placing a small glass capsule, weighted with a Pb shot, in the mol. wt. tube. The annular space between the capsule and tube wall contains only a thin layer and the first appearance of crystals can easily be detected. The f.p. method requires less time and manipulation than the m.p. procedure and results of the same degree of accuracy ($\pm 5\%$) are obtained. J. D. R.

Apparatus for the study of physico-chemical properties of solutions and for carrying out reactions in liquefied gases under pressure. A. I. Schattenstein (*Acta Physicochim. U.R.S.S.*, 1940, 13, 604—616).—Apparatus, in which metal (stainless steel) and glass units are combined, is described. F. J. G.

High-vacuum gauge. Anon. (*J. Sci. Instr.*, 1941, 18, 116).—The "Vacustat," having a range of 10—0.01 mm. Hg, is a small, portable instrument of which the principle of operation is similar to that of the McLeod gauge. Compression is achieved by rotation about the centre. A. A. E.

Recording sensitive differential manometer. W. Hurst (*Rev. Sci. Instr.*, 1941, 12, 265—268).—Motion is transmitted from a thin rubber diaphragm, carrying a small Al plate, through a glass rod to a glass mirror. Thermal insulation is important. Use of an equalising valve avoids error due to small changes in barometric pressure. Pressure differences < 0.00003 cm. Hg and > 80 cycles per sec. may be recorded. A. A. E.

Low-pressure gauge. C. C. Coffin and J. R. Dingle (*Canad. J. Res.*, 1941, 19, B, 129—131).—An inexpensive, heat-conductivity, low-pressure manometer of average sensitivity which is based on the rate of sublimation of CO_2 from a mixture of solid CO_2 and Et_2O is described. C. R. H.

[Apparatus for] separation and purification of gases by fractional distillation at low temperatures.—See B., 1941, I, 252.

Quantity type rotor for the ultracentrifuge. A. V. Maskot (*Rev. Sci. Instr.*, 1941, 12, 277—279).—Holes accommodating the plugged Lusteroid test-tubes are drilled at 10° to the axis of the duralumin rotor. The seal remains vac.-tight under 3000 lb. per sq. in. at 57,000 r.p.m. The rotor would probably explode at about 72,000 r.p.m. The instrument has been applied to the differential sedimentation and concn. of proteins. A. A. E.

Quantitative separation of some dyes. Application of the chromatographic method. W. Rieman, 3rd (*J. Chem. Educ.*, 1941, 18, 131—133).—Apparatus and method for separating Merck's blue B, crystal-violet, and auramine by means of Verck's ignited Al_2O_3 are described. L. S. T.

Apparatus for extraction of lipins from liquids and solids.—See A., 1941, III.

XIII.—GEOCHEMISTRY.

Analysis of water of the thermal springs of Vrnjačka Banja. S. Miholić (*Bull. Soc. Chim. Yougoslav.*, 1939, 10, 163—196).—Analytical data are recorded. R. T.

Mineral water from Surangudi. T. N. Muthuswami (*Current Sci.*, 1941, 10, 172—173).—The H_2O contains total solids 286, Cl 7, SiO_2 164, R_2O_3 15, CaO 5, MgO 0.6 p.p.m. Ba, Sr, K, Cr, Sn, Ti, Rb, Mn, Pb, and Cu were also detected spectroscopically [P. K. Seshan]. Features of the geology of the area are noted. A. J. E. W.

Evaporation of salt water in relation to meteorological factors. II. Coefficient of slow evaporation of salt pans of the Unión Salinera de España. C. Chorower (*Anal. Fis. Quím.*, 1941, 37, 69—113).—The variation of the coeff. of evaporation with humidity is recorded. It also decreases as the d of the saline liquid increases. The coeff. exhibits rapid decreases during the pptn. of NaCl and MgSO_4 . F. R. G.

Osbornite, meteoritic titanium nitride. F. A. Bannister (*Min. Mag.*, 1941, 26, 36—44).—Osbornite has been found only in the Bustee meteoritic stone (fell in India in 1852) as minute regular octahedra with golden-yellow colour and metallic lustre, embedded in oldhamite (CaS). It was described by Story-Maskelyne in 1870 as an oxysulphide of Ca and Ti (or Zr). The X-ray patterns give a cubic cell of edge a 4.235 Å. with the rock-salt type of structure, identical with that (a 4.23 Å.) of TiN. A crystal heated in air at 350° (well below the m.p.) lost its sharp edges and developed polycryst. surfaces, then consisting of a pseudomorph of rutile in regular orientation. The presence of Ti was also confirmed by qual. tests, but not of Ca. TiC has the same structure with a 4.31 Å. The "Ti cyanonitride, $\text{Ti}(\text{CN})_2 \cdot 3\text{Ti}_2\text{N}_2$ " of Wöhler, 1850 (A., 1929, 18, 524), found as copper-red cubes in blast-furnace slags and "bears," is $\text{Ti}(\text{N,C})$ with a 4.23—4.24 Å. "Cochranite, $\text{Ti}(\text{CN})_2$ " of Stead, 1913, is Ti_2CN with a 4.27 Å. L. J. S.

Intermediate regions in plastically deformed crystals of rock-salt. V. I. Startzev (*Compt. rend. Acad. Sci. U.R.S.S.*, 1941, 30, 124—125).—The nature of bands parallel to the 110 direction in a plastically deformed crystal of rock-salt has been investigated by the Laue method. It is concluded that the lattice is distorted along the band so that it represents a series of intermediate orientations. Annealing at 600° for 50 hr. had no effect on the bands. A. J. M.

Boron in Chibiny apatites. A. I. Volodtschenkova (*Compt. rend. Acad. Sci. U.R.S.S.*, 1941, 30, 140—143).—The Me borate technique was used for the determination of B in apatites. The B_2O_3 content of Chibiny apatites is approx. 0.007%. The presence of B in apatites should be borne in mind in the use of these phosphates as fertilisers. A. J. M.

Identification of clay minerals by means of aggregate X-ray diffraction diagrams. G. Nagelschmidt (*J. Sci. Instr.*, 1941, 18, 100—101).—By evaporating clay suspensions on a flat surface, the particles are mainly oriented with their basal planes parallel to the plane of sedimentation. The basal spacing reflexions thus obtained with an X-ray spectrometer can be more accurately identified than those obtained with powder diagrams. These spacings are the best characteristics for differentiating between clay minerals or groups of such minerals, especially if several occur in a mixture and their grain-sizes are small. D. F. R.

Paragenesis of elements and minerals in colloids of soils and clays. I. Sedletzki (*Compt. rend. Acad. Sci. U.R.S.S.*, 1941, 30, 160—162).—The composition of colloids in soils and its dependence on that of accompanying minerals have been investigated. A. J. M.

Distribution of copper in the main soil types of the U.S.S.R. I. Sedletzki and D. Ivanov (*Compt. rend. Acad. Sci. U.R.S.S.*, 1941, 30, 51—53).—Data are recorded for a variety of soil types and are correlated with weathering effects. L. J. J.

Modern developments in geological exploration for petroleum. A. Wade (*J. Proc. Austral. Chem. Inst.*, 1941, 8, 61—70).—A review.

Applications of high pressures in geological and geophysical research. M. P. Volarovitch (*Bull. Acad. Sci. U.R.S.S., Cl. Sci. Chim.*, 1940, 985—996).—A review. R. T.

BRITISH CHEMICAL AND PHYSIOLOGICAL ABSTRACTS

A., I.—General, Physical, and Inorganic Chemistry

SEPTEMBER, 1941.

I.—SUB-ATOMICS.

Resonance broadening of the sodium D lines. K. Watanabe (*Physical Rev.*, 1941, [ii], 59, 151—153).—Determinations for 10^{-3} —70 mm. v.p. of Na were made by direct measurement of the contours of the line wings. Over nearly the entire range the half-intensity width varied linearly with the density of the absorbing atoms, i.e., $\Delta\nu_1/N = 0.80 \times 10^{-7}$ per sec. per c.c., the const. being 1.6 times that predicted by theory but \ll the corresponding experimental results for K (cf. Hughes, A., 1938, I, 108). Above 5 mm. pressure, $\Delta\nu_1$ increased slightly faster than N , and the contour for the absorption coeff. was represented by an inverse-cube rather than by an inverse-square contour. Somewhat contrary to theory, the relative width $\Delta\nu_1/\Delta\nu_1^0$ was 1.12 instead of 1. No definite evidence of van der Waals force was observed at the higher pressures, and no appreciable shifts or asymmetries. The natural width measured was consistent with previous results.

N. M. B.

Interferometric measurements of certain lines in the spectrum of bromine. M. G. Sastry (*Indian J. Physics*, 1940, 14, 429—433).—The $\lambda\lambda$ of 9 lines in the Br II spectrum, including the super-quintet $5s^6S$ — $5p^6P$, have been measured and the intervals of the $5p^6P$ level have been determined accurately.

W. R. A.

First spark spectrum of tellurium. I. K. R. Rao and M. G. Sastry (*Indian J. Physics*, 1940, 14, 423—427).—The spectrum of Te^+ excited in condensed discharges through Te vapour in quartz capillary tubes and in vac. sparks between Al electrodes tipped with Te has been examined. A related system of quartet and doublet terms has been set up, involving the characteristic terms of the $5s$, $6s$, and $6p$ electron configurations of Te^+ . The ionisation potential of Te^+ is ~ 21.5 v.

W. R. A.

Absolute f -values by the method of total absorption. R. B. King and D. C. Stockbarger (*Astrophys. J.*, 1940, 91, 488—502).—Apparatus for measuring the abs. f -vals. of spectral lines is described. For the Cd line 3261 Å. and the Cu resonance lines 3247 and 3274 Å. the f -vals. obtained are 0.0023, 0.62, and 0.32, respectively.

L. S. T.

Low terms in Co VII and Ni VIII. E. E. Anderson and J. E. Mack (*Physical Rev.*, 1941, [ii], 59, 717—723; cf. Bowen, A., 1938, I, 337).—Data for the levels $3d^3^4F^2GDH$ (and 4P) and $3d^24p(^3F)^4GFD(^3P)^4DPS(^4G)^2HG$ are tabulated, classified, and discussed. First differences in the Sc-like isoelectronic sequence are plotted. The sharp decline in certain of the odd levels can be explained by the approach of undiscovered levels of the $3p^44d^4$ configuration which are expected to cross $3d^24p$ near this stage of ionisation.

N. M. B.

Zeeman effect of the forbidden lines of Pb I. I. Pure quadrupole and magnetic dipole lines. F. A. Jenkins and S. Mrozowski (*Physical Rev.*, 1941, [ii], 59, 808—813; cf. A., 1941, I, 66).—An intense source of the forbidden lines, consisting of a high-frequency discharge through He containing a small amount of Pb vapour, is used to photograph the Zeeman patterns in fields up to 4000 gauss. The Zeeman effect of the hyperfine structure of forbidden lines is observed for the first time. For the main hyperfine component, due to the even isotopes, the transverse effects in a magnetic dipole line, $\lambda 4618$, and in two quadrupole lines $\lambda\lambda 4659$ and 5313 are recorded. The reversal of polarisation in $\lambda 4618$ is shown. The splittings of the weaker hyperfine components emitted by ^{207}Pb are also observed for $\lambda\lambda 5313$ and 4618, including, in the latter case, fields strong enough to show the Back-

309

I (A., I.)

Goudsmit effect. Splittings and intensities accord with theory. The electric dipole intensity formulae apply to magnetic dipole lines and the Rubinowicz quadrupole formulae to quadrupole lines.

N. M. B.

Physical processes in gaseous nebulae. IX. Excitation of fractional multiplets by electron capture. G. H. Shortley and D. H. Menzel (*Astrophys. J.*, 1940, 91, 307—319; cf. A., 1940, I, 138).—Certain permitted multiplets of O III and N III are not completely represented in the spectra of gaseous nebulae. Bowen's resonance absorption mechanism explaining this phenomenon is discussed; it is probably correct. Direct electron capture by an ion in the ground level of a term is examined as a possible method of excitation of fractional multiplets, but the components predicted by quantum mechanics do not agree with those observed in the nebulae.

L. S. T.

Rowland intensity scale. D. H. Menzel, L. Goldberg, and E. M. Cook (*Astrophys. J.*, 1940, 91, 320—333).—A new calibration of Rowland's scale of solar intensities has been derived by means of the theoretical strengths of multiplets in transition arrays. 37 arrays, representing 13 metals and 1119 lines, have been used, and give a calibration that is much less steep than that of Russell *et al.*

L. S. T.

Solar eruptions. R. G. Giovanelli (*Astrophys. J.*, 1940, 91, 334—349).—Observations of 268 recent eruptions have been analysed to show relative distributions of intensities and areas. During eruptions the width of the H_α line is const. for small intensities, but increases rapidly when the intensity equals or exceeds that of the continuous spectrum. In general, eruptions are confined to levels in which the normal bright H occurs.

L. S. T.

Effect of continuous Balmer absorption on the equivalent widths of stellar absorption lines. O. Struve and F. Sherman (*Astrophys. J.*, 1940, 91, 428—437).—Continuous Balmer absorption on the short- λ side of 3647 Å. tends to weaken the absorption lines of various elements. From the equiv. widths of 48 lines of Ti II the ratio of the continuous absorption coeffs. on both sides of 3647 Å. is 16 in η Leonis, 10 in α Cygni and α Lyrae, and 2 in ν Sagittarii. H abundance is great in the first three stars, but low in the fourth (see following abstract).

L. S. T.

Spectrum of ν Sagittarii. J. L. Greenstein (*Astrophys. J.*, 1940, 91, 438—472).— $\lambda\lambda$, intensities, and identifications of 400 lines in the region 3317—3975 Å. are tabulated. H lines are very weak, whilst those of all series of He are strong. Singly-ionised metals are dominant, but a few weak lines of Fe I, Mg I, and Cr I are present. The Fe II spectrum is particularly strong, and includes many new predicted lines from high-level transitions. The abundance of He is approx. 100 times that of H, and that of H 100 times that of Fe.

L. S. T.

Spectrographic observations of peculiar stars. P. Swings and O. Struve (*Astrophys. J.*, 1940, 91, 546—620).—Spectra of several absorption O-type stars showing vestiges of Wolf-Rayet emission have been investigated from 3300 to 6700 Å. The absorption spectrum consists chiefly of H, He II, He I, O III, O IV, N III, N IV, and Si IV. The emission lines are confined to H, He I, and a few transitions of He II, N III, N IV, N V, C III, and Si IV. The visual spectrum of P Cygni shows strong Fe III lines originating from metastable levels, whilst lines of other elements show a peculiar selectivity of the emission lines. RY Scuti shows a strong system of forbidden Fe III lines. A group of stars showing forbidden Fe II lines is discussed; new forbidden Fe II multiplets have been found in the ultra-violet. Spectra of four binary

310

systems showing simultaneously an *M*-type spectrum and forbidden lines of high excitation are described in detail. *AX Persei* and *CI Cygni* have bright-line spectra, of which the nebular part shows a very high excitation; besides H , $He I$, and $He II$, the strongest lines are due to $Fe VII$ and $Ne V$, and there is evidence of $Fe X$. The temp. of the nucleus exciting these nebular lines must be $\sim 150,000^\circ$.

L. S. T.

Diffuse matter in interstellar space. O. Struve (*J. Washington Acad. Sci.*, 1941, 31, 217—258).—A lecture with the following sectional headings: the emptiness of space, dispersion of light in space, general absorption, selective absorption, diffuse radiation, dynamical considerations, interstellar gases, the ionisation paradox, solution of the paradox, interstellar H emission, emission of forbidden O, interstellar emission or absorption, composition of interstellar gas.

L. J. J.

Two interesting nuclei of planetary nebulae: IC 418 and NGC 40. P. Swings and O. Struve (*Proc. Nat. Acad. Sci.*, 1941, 27, 225—229).—The nucleus of the planetary nebula IC 418 shows bright lines of $N III$ and $C III$ of similar intensity. NGC 40 has a pure *WC* nucleus, surrounded by a nebulosity rich in N . Nuclear spectrograms show that N is absent or extremely weak compared with C . The planetary nuclei are shown to belong to one or other of these two types.

A. J. M.

X-Ray spectra arising from the valency band-*L* transitions of tungsten, tungsten oxide, and platinum. J. A. Bearden and T. M. Snyder (*Physical Rev.*, 1941, [ii], 59, 162—168).—X-Ray emission lines and absorption edges were studied with a double-crystal spectrometer. Observed shapes of the *W* absorption edges are in good agreement with the calc. density (cf. Manning, A., 1939, I, 12) of states in the *5d* and *6s* bands of *W*, but the *W* emission lines have not the structure expected from calculation and are 4.5 e.v. narrower than the region of occupied states calc. for these bands. A comparison of *W* and *WO₃* spectra shows that the initial absorption max. of the *L_{II}* and *L_{III}* edges is broader and higher in *WO₃*, the *L* edges are shifted 2.5 e.v. to higher frequencies, and the emission lines are ~ 3 e.v. wider. A qual. explanation of these differences is given in terms of the high electronegativity of O. The observed Pt absorption-edge structures are in qual. agreement with expectations from other properties of the metal. A marked difference in the relative intensity of corresponding structure features of the *L_{II}* and *L_{III}* edges is ascribed to a spin-orbit coupling of the valency electrons.

N. M. B.

Fluorescent *K* X-rays from ions in solution and from gases. T. M. Snyder (*Physical Rev.*, 1941, [ii], 59, 168—170).—With the improved intensity-measuring technique for weak X-rays (cf. Bearden, A., 1935, 1047), a comparison of the *K α* lines emitted by Co, Ni, Cu, and Br in compounds with the lines emitted by the free elements shows that chemical combination broadens the lines and increases their asymmetry. The effect was greatest for Co, progressively smaller for Ni and Cu, and unobservable for Br. The lines were unchanged in aq. solutions of the compounds regardless of dilution. The *K α* doublets of liquid and gaseous Br were identical, showing that the state of physical aggregation has no effect on the *K α* lines of this element.

N. M. B.

Detailed analysis of gold *L* spectrum. E. A. Woodall (*Phil. Mag.*, 1941, [vii], 32, 1—32).—30 diagram lines and several spark lines of Au in the *L* spectrum have been measured relative to the *K α* lines of 7 elements from Cu to Mo. A table of energy levels for Au from *L_I* onwards is calc. from the measurements, using Sandström's val. 877.70 for *L_{III}*.

L. J. J.

Variation of the atomic structure factor with wave-length in the region of anomalous dispersion. S. Yoshida (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, 38, 263—271).—The intensity distribution in the region of an X-ray absorption edge for white radiation reflected by single crystals of molybdenite, quartz, $NaClO_3$, vivianite, gypsum, Fe pyrites, stibnite, scheelite, and sylvine has been investigated qualitatively. For the first three the intensity distribution curve shows an increase of reflexion on the short- λ side of the absorption limit. The effect of surface treatment has been investigated. Observed curves have been compared with variation curves of the at. structure factor with λ computed by dispersion theory; similarity between the two curves

is exhibited with perfect crystals, but mosaic crystals show pronounced deviations.

W. R. A.

***K* absorption edge of iron in various chemical states.** S. Yoshida (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, 38, 272—280).—The *K* absorption edge and *K β* emission band of Fe have been investigated for Fe, for alloys of Fe with Ni, Mn, and Si, for Fe^{II} and Fe^{III} salts, for complex cyanides of Fe, and for Fe sulphides and oxides. α - and γ -Fe show different types of fine structures of the main edge, and the *K β* band of Fe has an asymmetrical shape with its short- λ edge coinciding with the main absorption edge. Fe^{II} and Fe^{III} salts, and the complex salts, whilst showing distinctive fine structures for each group, exhibit identical structures for members constituting a group.

W. R. A.

Electron emission of metals in electric fields. II. Field dependence of the surface photo-effect. E. Guth and C. J. Mullin (*Physical Rev.*, 1941, [ii], 59, 867—873; cf. A., 1941, I, 285).—The influence of an applied field on the emitted photo-electric current is investigated, and an expression for the current is derived. It contains a term analogous to the Schottky term for thermionic emission and also a term periodic in the field intensity similar to that found for thermionic emission. For frequencies near the threshold and fields of 3×10^5 v. per cm., the periodic term is $\sim 4\%$ of the non-periodic part of the current.

N. M. B.

Thermodynamic interpretation of certain thermionic and thermo-electric phenomena. C. Herring (*Physical Rev.*, 1941, [ii], 59, 889—896).—Mathematical. The relationship of steady-state thermionic phenomena to the thermo-electric properties of the metal is developed for a metal of arbitrary cryst. symmetry. Application is made to the interpretation of experimental measurements of the contact p.d. between metal surfaces at different temp., and of the cooling effect accompanying thermionic emission.

N. M. B.

Energy losses attending thermionic emission of electrons from metals. W. B. Nottingham (*Physical Rev.*, 1941, [ii], 59, 906—907).—A crit. discussion of a recent paper by Fleming and Henderson (cf. A., 1941, I, 139).

N. M. B.

Energy losses attending thermionic and field emission. (Miss) G. M. Fleming and J. E. Henderson (*Physical Rev.*, 1941, [ii], 59, 907—908).—A reply to Nottingham (cf. preceding abstract).

N. M. B.

Interstellar radiation from free electrons and hydrogen atoms. L. G. Henyey and P. C. Keenan (*Astrophys. J.*, 1940, 91, 625—630).

L. S. T.

Measurement of cathode emission by use of the electron microscope. G. W. Fox and F. M. Bailey (*Physical Rev.*, 1941, [ii], 59, 174—178).—The electron microscope, used in connexion with photographic technique for quant. measurements of electron emission from BaO , SrO , and CaO , forms an excellent emission comparator. Time-lapse exposures allow observation of activation processes to be made in detail. The emitting properties of Ba compounds other than BaO are compared.

N. M. B.

Anode spots in oxygen. J. E. Henderson and S. M. Rubens (*Physical Rev.*, 1941, [ii], 59, 213—214).—In order to test whether the absence of anode spots in O_2 , analogous to those in N_2 (cf. A., 1940, I, 425), might be due to the non-attainment of a sufficiently high voltage, the N_2 experiment was repeated with O_2 , but with a probe ≤ 5 v. positive with respect to the anode. A bright, pale green glow covered the probe, and the probe current rose discontinuously. The current-voltage curve is given. At 13.2 v. the glow changed to four bright hemispherical spots equally spaced around the probe edge, and these rotated when the probe potential was increased. Results indicate that anode spots might form spontaneously in O_2 at sufficiently great c.d. The lower limit of c.d. is ~ 100 ma. per sq. cm. The probe potential, 12.7 v., at which the current max. occurs accords with the first ionisation potential, 13.0 v., of O_2 . A suggested mechanism is discussed.

N. M. B.

Calorimetric determination of the radiation loss of energy of fast electrons in lead. K. D. Sinelnikov, A. K. Walter, and A. V. Ivanov (*Physical Trans. Ukrain. Acad. Sci.*, 1940, 9, 47—53).—An electron beam having the energy of 2 Me.v. was alternately absorbed in a Li and a Pb calorimeter. The heat evolved in the Pb calorimeter was $7\% <$ that in Li;

this difference is due to radiation loss in Pb and its magnitude is consistent with the theory of Bethe and Heitler. J. J. B.

Variations in the relative abundance of the carbon isotopes. B. F. Murphy and A. O. Nier (*Physical Rev.*, 1941, [ii], 59, 771—772; cf. A., 1939, I, 231).—Previous results are confirmed and extended in a mass spectrometer investigation of the $^{12}\text{C}/^{13}\text{C}$ abundance ratio for 57 specimens of widely different geological age and geographical origin. A maximum variation of 5% was found. N. M. B.

Stable isotopes of nickel. G. E. Valley (*Physical Rev.*, 1941, [ii], 59, 836—837).—Mass-spectrometer measurements give the relative abundances ^{58}Ni 67.4, ^{60}Ni 26.7, ^{61}Ni 1.2, ^{62}Ni 3.8, and ^{64}Ni 0.88. The calc. chemical at. wt. is 58.71 ± 0.02 in agreement with the International val. The ratio ^{61}Ni : ^{64}Ni agrees with that given by Straus (cf. A., 1941, I, 233). N. M. B.

Explorations in stereochemistry. XII. At. wt. of silver. S. Bull (*Stereochem.*, 1939, 3, 21—31).—Speculative. W. J.

Measurement of the total number of neutrons emitted by the permanent radium-beryllium source of the radioactivity laboratory of the Physico-Technical Institute [of the Academy of Science, Charkov]. T. D. Gundobina (*Physical Trans. Ukrain. Acad. Sci.*, 1940, 9, 85—89).—1 mg. of Ra gives rise to 20,000 neutrons per sec. Fermi's method and the measurement of the activity of Mn from irradiated KMnO_4 solution give consistent results. J. J. B.

Absorption of neutrons by boron, chlorine, cobalt, and manganese. W. J. Horvath and E. O. Salant (*Physical Rev.*, 1941, [ii], 59, 154—162).—Transmission curves and absorption curves for B and several elements which capture the neutrons without activity, or with very weak activity, were obtained. Rh, In, Ag, Mn, Br, and I were used as thermal and resonance detectors, and their known B absorption coeffs. were redetermined. The resonance levels of only Rh and In appear to be single. By comparing the B absorption coeffs. with the absorption coeffs. of the non-radioactive elements, resonance levels were located for ^{36}Cl near 1 v., for ^{58}Co near 1 and 30 v., and for Mn below 0.4 v. N. M. B.

Thermal neutrons in the atmosphere. S. D. Chatterjee (*Indian J. Physics*, 1940, 14, 435—440).—The intensity of atm. thermal neutrons has been measured at 70 and 7000 ft. above sea level, using a B-lind proportional counter. At the higher altitude the size-frequency distribution of the energies of the disintegration particles from B by the action of atm. neutrons has been measured with a BF_3 ionisation chamber. W. R. A.

Artificial radioactivity and the cyclotron. H. R. Woltjer (*Natuurwetensch. Tijds. Ned. Indië*, 1941, 101, 122—132).—A lecture. S. C.

Photographic plate spectrum of the neutrons from the disintegration of lithium by deuterons. H. T. Richards (*Physical Rev.*, 1941, [ii], 59, 796—804).—The energy spectrum of the neutrons from $\text{Li} + ^2\text{H}$ was studied by the photographic emulsion technique. The broad 10.8-Me.v. neutron group reported by Stephens (cf. A., 1938, I, 169) from He recoil data is confirmed. There is evidence that not all the neutrons from this group correspond with the 2.8-Me.v. excitation level in the residual ^8Be nucleus, and that there are at least two higher (7.5 and 10 Me.v.) levels in ^8Be . The technique is discussed and the stopping power of the emulsion for three different proton energies was found. N. M. B.

High energy γ -ray from $\text{Li} + \text{D}$. W. E. Bennett, T. W. Bonner, H. T. Richards, and B. E. Watt (*Physical Rev.*, 1941, [ii], 59, 904—905).—The max. range of the Compton electrons in Al, measured by coincidence counters, was 8.7 mm. corresponding with 4.9 ± 0.3 Me.v. γ -ray energy compared with 440 ke.v. reported by Williams (cf. A., 1937, I, 593). The γ -ray intensity is 3.0×10^6 quanta per μ -coulomb, and the ratio of γ -rays to neutrons is 3.3%. It was shown that the γ -rays were not produced by inelastic scattering of the neutrons from Li in neighbouring materials. There is strong evidence that the γ -ray is produced by bombardment of ^7Li and not of ^6Li . N. M. B.

Disintegration of carbon by deuterons. W. E. Bennett, T. W. Bonner, E. Hudspeth, H. T. Richards, and B. E. Watt (*Physical Rev.*, 1941, [ii], 59, 781—792; cf. A., 1940, I, 383).—Excitation curves for emission from ^{12}C disintegration by

deuterons show resonances at 0.92, 1.16, 1.30, 1.43, and 1.74 Me.v. for γ -rays, at 0.92, 1.16, 1.30, 1.74, and 1.82 Me.v. for neutrons, and at 0.92, 1.16, 1.23, and 1.74 Me.v. for protons. The γ -rays from ^{12}C come from the reaction $^{12}\text{C}(d, p)^{13}\text{C}$, and the short-range protons (1.1 cm.) are observed; the Q val. for this proton group is -0.52 ± 0.07 Me.v. For ^{13}C disintegration, the excitation curves for the emission of γ -rays and protons show a resonance at 1.55 Me.v. deuteron energy. The γ -rays from ^{13}C have 5.5 Me.v. energy and come from the reaction $^{13}\text{C}(d, n)^{14}\text{N}$. The low-energy group of neutrons from this reaction is found when a 23% ^{13}C target is used; the Q val. for the group is 0.40 Me.v. The relative and abs. yields of the various reactions are determined. N. M. B.

Energy of the γ -rays from the disintegration of fluorine by protons and deuterons. W. E. Bennett, T. W. Bonner, and B. E. Watt (*Physical Rev.*, 1941, [ii], 59, 793—795; cf. Lauritsen, A., 1941, I, 187).—The energy of the γ -rays from the disintegration of a thick F target by protons was the same at 0.90 and 1.7 Me.v. bombarding voltages. The γ -rays from the disintegration of F by 1.3-Me.v. deuterons were complex and had 6.7 ± 0.3 Me.v. max. energy. This indicates that the highly excited states of ^{20}Ne at 9.0 and 10.1 Me.v. found in the reaction $^{19}\text{F}(d, n)^{20}\text{Ne}$ (cf. A., 1940, I, 186) break up into ^{16}O and ^4He instead of emitting γ -rays. N. M. B.

Pair production by γ -rays from fluorine bombarded with protons. K. Shinohara and M. Hatoyama (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, 38, 253—262, 326—327).—Pair production by γ -rays from F bombarded with protons has been investigated in a cloud chamber and the energy of the γ -rays has been calc. as 6.2 Me.v., in good agreement with recorded data. The probability of division of energy between positive and negative electrons is discussed. W. R. A.

Radioactive Rb from deuteron bombardment of Sr. A. C. Helmholtz, C. Pecher, and P. R. Stout (*Physical Rev.*, 1941, [ii], 59, 902; cf. A., 1941, I, 143).—Rb (19.5 ± 1 days) has been obtained by the reaction $\text{Sr}(d, \alpha)\text{Rb}$ by 16-Me.v. deuteron bombardment. Quant. chemical separation is described and the activity is identified as ^{86}Rb (cf. Snell, A., 1939, I, 8); it emits negative electrons and no strong γ -rays; the spectrum has an upper limit of 1.56 ± 0.05 Me.v. Mechanism and yield are discussed. N. M. B.

Fission products of uranium and thorium produced by high-energy neutrons. E. Segrè and G. T. Seaborg (*Physical Rev.*, 1941, [ii], 59, 212—213; cf. Nishina, A., 1941, I, 3).—With ~ 17 -Me.v. neutrons (16-Me.v. ^2D on Be) from a cyclotron the following chains from U and Th fission were observed: ^{112}Pd (17 hr.) \rightarrow ^{112}Ag (3.4 hr.) \rightarrow ^{112}Cd (stable), and ^{111}Pd (26 min.) \rightarrow ^{111}Ag (7.5 days) \rightarrow ^{111}Cd (stable). A discrepancy from the results of Kraus (cf. A., 1938, I, 8), who reports ^{111}Pd (17 min.) by deuteron bombardment of Pd, is unexplained. Ru (~ 4 hr.) has been found in the fission products of U and Th. During the neutron bombardment of Pd, 107* , $^{109*}\text{Ag}$ (40 sec.), which may be the same as Ag (40 sec.) formed as the decay product of 107 , ^{109}Cd (6.7 hr.) (cf. Alvarez, A., 1940, I, 279), was observed to grow from 107 , ^{109}Pd (13 hr.). N. M. B.

Effect of neutron energy on the total decay curves of fission products. S. K. Haynes (*Physical Rev.*, 1941, [ii], 59, 834—835).—Decay curves from measurements made to examine the discrepancies between Joliot's (cf. A., 1940, I, 235) and Bjerger's (cf. *ibid.*, 444) results indicate a tendency towards shorter periods at increasing energies. N. M. B.

Proton-induced fission. G. Dessauer and E. M. Hafner (*Physical Rev.*, 1941, [ii], 59, 840—841; cf. Jacobsen, A., 1941, I, 144).—Experiments on the bombardment of Th and U with 6.9-Me.v. protons from a cyclotron are reported and discussed. N. M. B.

Cloud tracks of cosmic rays in the stratosphere. G. Herzog (*Physical Rev.*, 1941, [ii], 59, 117—122).—Cloud-chamber photographs taken in flights up to 29,000 ft. show 51 slow mesotrons and 39 proton tracks at heights $> 15,000$ ft., with an indication, in one case, of a slow mesotron shower. Some of the tracks with very high sp. ionisation may be due to the fragments of heavy nuclei. Results indicate that slow mesotrons occur in appreciable nos. above 20,000 ft. N. M. B.

Cloud-chamber pictures of cosmic rays at 29,000 feet altitude. G. Herzog and W. H. Bostick (*Physical Rev.*, 1941, [ii], 59, 122—126; cf. preceding abstract).—The range of slow mesotrons was investigated by inserting a Cu plate across the middle of the chamber; their rate above 15,000 ft. is 9.6% of the occurrence rate of electrons and fast mesotrons. One proton, and the formation of a pair of positive and negative slow mesotrons, were photographed. Statistical evidence is given that mesotrons do not always disintegrate when stopped. N. M. B.

Fast neutrons and particles with high specific ionisation in the cosmic radiation at high elevations. S. A. Korff (*Physical Rev.*, 1941, [ii], 59, 214; cf. A., 1940, I, 280).—Calculations on neutron density and current, and current of particles of high sp. ionisation, obtained from measurements with proportional counters in stratosphere flights, are reported. N. M. B.

Latitude effect of cosmic rays above 50° N. latitude. P. F. Gast and D. H. Loughridge (*Physical Rev.*, 1941, [ii], 59, 127—129; cf. Compton, A., 1938, I, 9).—Measurements by a continuously operating ionisation-type meter mounted on shipboard give a monthly mean temp. coeff. of $-0.09 \pm 0.03\%$ per degree. When this correction is applied, the latitude-intensity curve is flat within the limits of probable error over the magnetic latitude range $53^\circ 30' - 61^\circ 36' N$. N. M. B.

Cosmic rays in the Bering Sea. P. F. Gast and D. H. Loughridge (*Physical Rev.*, 1941, [ii], 59, 769—770; cf. preceding abstract).—Intensity-latitude data are analysed, plotted, and discussed. Results show that a drop previously found at the high-latitude end of the curve is a local phenomenon due to the "horizon effect," and that intensity is independent of latitude up to $68^\circ 22' N$. N. M. B.

Geomagnetic character and cosmic-ray intensity pulses. J. W. Broxon (*Physical Rev.*, 1941, [ii], 59, 909; cf. A., 1941, I, 289).—Supplements an earlier note by quoting the work of Forbush (*Bull. Int. Union Geod.*, 1940, 11, 438). N. M. B.

Recurrence phenomena in cosmic-ray intensity. J. W. Broxon (*Physical Rev.*, 1941, [ii], 59, 773—776).—Application of Chree's method of geomagnetic analysis to cosmic-ray intensity measurements shows secondary pulses of intensity in the difference curves. These pulses occur at ~ 28 -day intervals before and after the primary pulse (cf. Gill, A., 1939, I, 236; Monk, A., 1940, I, 189). N. M. B.

Energy distribution and composition of the primary cosmic-ray particles. N. Hilberry (*Physical Rev.*, 1941, [ii], 59, 763—764; cf. Bowen, A., 1938, I, 382).—An expression based on experiment is given for the energy distribution. From this, the no. of particles from all directions on top of the atm. in the energy range $(0.67-1.7) \times 10^{10}$ e.v. is 0.9 per sq. cm. per sec., and for those with energies $> 1.70 \times 10^{10}$ e.v. the energy carried into the atm. per sq. cm. per sec. from all directions is 8.9×10^8 e.v. There is evidence of only one kind of primary cosmic-ray particle (probably the proton) in any significant amount. Consequences are examined and discussed. N. M. B.

Single component for the primary cosmic radiation. W. F. G. Swann (*Physical Rev.*, 1941, [ii], 59, 770—771).—The conclusions reported by Schein *et al.* (cf. A., 1941, I, 289) have been cited from other considerations (cf. A., 1940, I, 189). The conclusions are recapitulated and discussed. N. M. B.

Single component in primary cosmic radiation. W. F. G. Swann (*Physical Rev.*, 1941, [ii], 59, 836; cf. A., 1940, I, 189, and preceding abstract).—Further evidence in support of a single component is reported. Variation of mesotron intensity with altitude follows an exponential law with a single coeff. when plotted against true distance, but when plotted against H_2O -equiv. distance the curve is compressed parallel to the distance axis so as to give an apparent increase of absorption coeff. with altitude. N. M. B.

Showings of penetrating particles. M. D. de S. Santos, P. A. Pompeia, and G. Wataghin (*Physical Rev.*, 1941, [ii], 59, 902—903; cf. A., 1940, I, 188).—Experiments with a six-fold coincidence set are reported and discussed. It is concluded that meson showers are responsible for some of the extensive showers discovered by Auger and co-workers. The observed showers are probably produced by vertical rays and contain several penetrating particles, at least two particles

penetrating > 20 cm. Pb. It is improbable that soft radiation, which always accompanies the penetrating component underground, is responsible for the observed showers.

N. M. B.

Production of mesotrons. J. F. Carlson and M. Schein (*Physical Rev.*, 1941, [ii], 59, 840).—Recent considerations (cf. A., 1941, I, 289) throw doubt on the validity of the accepted explanation of the atm. transition curve of cosmic rays. If the primary rays entering the atm. are mainly protons and not electrons, then to explain the production of the penetrating component (mesotrons) and the soft component (electrons and γ -rays) and their intensity curves in the atm. it is suggested that the protons create mesotrons in collisions with nuclear particles, and the mesotrons in turn decay, transferring part of their energy into an electronic component which gives rise to the soft component. A simplified quant. model of the process, based on a few reasonable assumptions, is proposed and discussed. N. M. B.

Rest mass of the mesotron. P. Weisz (*Physical Rev.*, 1941, [ii], 59, 845—849).—Mathematical. Available experimental vals. of the rest lifetime of the cosmic-ray mesotron are recalculated on the basis of the same assumed rest mass. Results still disagree, but are a function of the average path length of the radiation employed in each experiment. This, and other experimental findings, can be explained by assuming a distribution in rest masses. There is evidence that the corr. actual lifetime is \ll any measured val., and $\approx 5 \times 10^{-7}$ sec. as predicted by Yukawa. N. M. B.

Relative stopping powers of carbon and lead for slow mesons. M. A. Pomerantz and T. M. Johnson (*Physical Rev.*, 1941, [ii], 59, 143—148; cf. A., 1940, I, 92).—Measurements with an anti-coincidence arrangement of counters show that, for mesons of average energy $\sim 4 \times 10^7$ e.v., the stopping powers of 28.5 g. per sq. cm. of C and 24 ± 5 of Pb are equiv. This gives 0.84 ± 0.18 for the ratio of the stopping powers of equal masses of C and Pb, compared with 1.82 calc. on ionisation theory. The discrepancy is explained by scattering and transition effects; the data corr. for these effects show the equivalence in stopping power of 28.5 g. per sq. cm. of C and 45 ± 7 of Pb, giving a ratio 1.6 ± 0.3 in agreement with theory. Results indicate that in a dense absorber any additional absorption process is unimportant compared with ionisation for mesons of energy $\sim 4 \times 10^7$ e.v., or higher. N. M. B.

Radioactivity of slow mesotrons. F. Rasetti (*Physical Rev.*, 1941, [ii], 59, 706—708).—A beam of mesotrons selected by a fourfold coincidence counter system passes through 10 cm. of Fe, and the mesotron absorption is recorded by a battery of anticoincidence counters. It is found that a certain fraction of the stopped mesotrons is associated with the emission of an ionising particle from the absorber. A special coincidence recording system of resolving time $\sim 1 \mu$ -sec. establishes that the emission of the particles is delayed with respect to the passage of the mesotron by a few μ -sec. The delayed particles are interpreted as the electrons resulting from the β -decay of the mesotron. N. M. B.

Scattering of mesons of spin $\hbar/2$ by atomic nuclei. R. E. Marshak and V. F. Weisskopf (*Physical Rev.*, 1941, [ii], 59, 130—135).—Mathematical. The non-electric scattering of charged mesons by protons and neutrons is calc. as a first-order effect in the heavy electron pair theory of nuclear forces, which regards the mesons as heavy electrons or particles with spin $\hbar/2$, obeying the Dirac equation and differing from usual electrons only in their rest mass μ . An upper limit for the scattering cross-section of mesons by nuclear particles is derived; the cross-section is $< 4 \times 10^{-20}$ sq. cm. for mesons of energy $E = \mu c^2$, and $< 1.6 \times 10^{-20}$ for $E = 3\mu c^2$. These vals. are ~ 1000 times $<$ those from theory involving a meson spin \hbar , but agree with the upper limits of experiment. For meson energies large compared with the rest energy of the proton or neutron, the scattering cross-section increases linearly with energy, and first attains the val. 10^{-26} sq. cm. for meson energies $\sim 10^{11}$ e.v. N. M. B.

Correspondence between classical and quantum theories of neutral mesons. H. J. Bhabha (*Proc. Indian Acad. Sci.*, 1941, A, 13, 249—254).—Although there is strict correspondence between the classical and quantum theories of neutral mesons in the sense that the former theory is the mathematical limit of the latter as $\hbar \rightarrow 0$, there is no correspondence between the two theories in the looser sense, *i.e.*, where the quantum

formula goes over into the corresponding classical formula when the energy of the light quantum concerned is \ll some other const. with the dimensions of energy, occurring in the formula. This is because the classical theory of mesons contains only the fundamental const. χ , the rest mass of the meson, μ , being introduced only when the theory is quantised. Hence, it is not always possible to use the classical theory to calculate accurately the cross-section of any process, though the fact that the classical theory can, indeed, be used to a considerable extent for this purpose is due to the fortunate circumstance that the mass of the neutron M is $\gg \mu$. The classical theory could not give a correct indication of processes involving interaction of mesons with electrons or neutrinos, since the mass of the electron, m , which in this case replaces M , is $\ll \mu$.
A. J. M.

Scattering in the pair theory of nuclear forces. J. W. Weinberg (*Physical Rev.*, 1941, [ii], 59, 776—780).—Mathematical. The scattering of particles of spin $\frac{1}{2}$ and mesotronic mass m by heavy nuclear constituents is investigated by the Crichtfield-Teller pair theory (cf. A., 1939, I, 595). A formula for the cross-section is found, and the val. is $\sim 10^{-24}$ sq. cm. at low energies, compared with $\sim 10^{-28}$ sq. cm. observed for cosmic-ray mesotrons.
N. M. B.

Selection rules in β -decay. J. R. Oppenheimer (*Physical Rev.*, 1941, [ii], 59, 908).—The disintegrations $H + H \rightarrow D$, $^{10}Be \rightarrow ^{10}B$, and $^{14}C \rightarrow ^{14}N$ where in each case the parent nucleus would be expected to be largely 1S , and the product nuclei are known to be mainly $^3S + ^3D$, are slower by factors of $\sim 10^4$ — 10^7 than would be expected for allowed transitions of the observed energy. This anomaly is discussed, and it is suggested that the Gamow-Teller selection rules have a "threshold" such as would be involved if the corresponding neutrino had a rest mass. Consequences are examined.
N. M. B.

Photo-disintegration of the deuteron. W. Rarita, J. Schwinger, and H. A. Nye (*Physical Rev.*, 1941, [ii], 59, 209—211).—Mathematical. Calculations with Bethe's "cut-off neutral theory" (cf. A., 1940, I, 190) show that no significant evidence regarding the tensor coupling of the vector mesotron theory may be expected from rough measurements of the total photo-electric cross-section (cf. Fröhlich, *ibid.*, 143), and that more useful information will be obtained by studying the angular distribution of the disintegration particles.
N. M. B.

Deuteron disintegration by electrons. B. Peters and C. Richman (*Physical Rev.*, 1941, [ii], 59, 804—807).—Mathematical. The cross-section is calc. Near the threshold the "magnetic" cross-section is larger, increasing with the square while the "electric" cross-section increases with the cube of the energy. They become equal at ~ 600 ke.v. above the threshold when each has the val. 3.5×10^{-31} sq. cm.
N. M. B.

Lifetimes of nuclear levels with respect to electric multipole radiation. I. S. Lowen (*Physical Rev.*, 1941, [ii], 59, 835).—Calculations based on the use of the liquid drop model are reported.
N. M. B.

Radiative collision of neutrons with protons. T. Muto (*Physical Rev.*, 1941, [ii], 59, 837).—Mathematical. By a method similar to that for radiative scattering of charged particles in an at. field, an expression is deduced for the total cross-section for radiative emission in the collision of high-energy neutrons with protons. Results show that for 10^8 -e.v. neutrons the cross-section is $< 10^{-30}$ sq. cm. for the emission of 10^6 -e.v. γ -rays.
N. M. B.

Radioactivity produced in germanium. R. Sagane, G. Miyamoto, and M. Ikawa (*Physical Rev.*, 1941, [ii], 59, 904; cf. A., 1939, I, 172).—Previous results are amplified and discrepancies with the results of Seaborg (cf. A., 1941, I, 188) are discussed.
N. M. B.

Density distribution in the steady-state diffusion of neutrons. E. A. Uehling (*Physical Rev.*, 1941, [ii], 59, 136—143; cf. A., 1941, I, 2).—Mathematical. By carrying the method of Laplace transformations and inversions to its ultimate conclusion, an expression in closed form for the spatial distribution in density of diffusing particles is obtained, valid for incident currents of particles on the face of a half-infinite medium and for source distributions within the medium.
N. M. B.

Density and compressibility of nuclear matter. E. Feenberg (*Physical Rev.*, 1941, [ii], 59, 149—150).—Mathematical. The influence on nuclear radii of the Coulomb force E between protons is calc. by using the min. property of the energy eigenvalue. Several different methods of estimating the compressibility of nuclear matter yield qualitatively concordant results. A small correction to E is required by the finite val. of the compressibility, and this correction, the Coulomb "expansion" energy, is $\propto E^2$.
N. M. B.

Degenerate non-ideal gases. L. I. Schiff (*Physical Rev.*, 1941, [ii], 59, 751—757).—Mathematical. The partition function for a non-ideal quantum gas is calc. by considering the degeneracy exactly and the inter-particle forces only so far as binary collisions are concerned. In the absence of forces, this reduces to the ideal Einstein-Bose or Fermi-Dirac gas, rather than to the ideal classical gas. If the wave functions describing the two-particle collisions are known the partition function can be reduced to a set of quadratures.
N. M. B.

Phase transition in liquid helium. L. I. Schiff (*Physical Rev.*, 1941, [ii], 59, 758—763).—Mathematical. In order to investigate the influence of binary collisions on London's ideal Einstein-Bose gas model of liquid He, the method previously developed (cf. preceding abstract) is applied to a gas of He atoms having the density and temp. of liquid He. It is shown that the condensation temp. and the continuity of the sp. heat at this temp. are not affected. Calculations for a rigid sphere interaction of small radius show that the sp. heat is lowered near the condensation temp. It is possible that the phase transition observed in liquid He is characteristic of a condensed system and cannot be obtained from a gas approximation method.
N. M. B.

Structure of liquid helium. L. I. Schiff (*Physical Rev.*, 1941, [ii], 59, 839).—The existence of surface transfer films of liquid He II of ~ 100 atoms thickness accords with the usual theory of interat. forces. There is evidence for the assumption that He I consists of a single phase A and He II of a mixture of two phases A and B ; phase A can be understood in terms of an Einstein-Bose gas model, but this, applied to phase B , does not explain the sp. heat anomaly, and for phase B a more typically liquid model in which there exists a discrete energy level for each atom is tentatively proposed.
N. M. B.

Measurement of observables in relativistic quantum mechanics. O. Halpern and M. H. Johnson (*Physical Rev.*, 1941, [ii], 59, 896—901).—The question of how far observables in quantum theory permit accurate measurement if no assumptions are made about the vals. of conjugate variables is examined. The physical connexion between the uncertainty principle and the commutation relations is briefly discussed. A treatment of the γ -ray microscope indicates that even with small-angle diffraction no great improvement beyond the Compton λ can be obtained. An analysis of an ideal arrangement to measure electric field strengths leads to conclusions on the limits of measurement accuracy.
N. M. B.

Virial theorem in the theory of metals. R. Landshoff (*Physical Rev.*, 1941, [ii], 59, 906).—Mathematical. The theorem is established for the many-electron problem by calculation of the kinetic energy for a quantum-mechanical electron configuration.
N. M. B.

Dimensions. G. B. Brown (*Proc. Physical Soc.*, 1941, 53, 418—431).—A new treatment of the theory of dimensions is proposed, based on the use of numbers as symbols for certain aspects of nature. There are only two direct ways of doing this, the measurement of length and of time. The first involves the second, and they are related by a universal const. called the const. of interaction in preference to c . This leads to a simple formulation of the dimensions of physical quantities in terms of symbols representing length and time measurements only, and to a new use for dimensional equations in checking theoretical predictions of relations between physical quantities such as mass and energy.
N. M. B.

Dimensions of physical quantities. W. E. Duncanson (*Proc. Physical Soc.*, 1941, 53, 432—448).—Existing discrepancies are attributed mainly to lack of exact definitions of terms and assumptions used. In addition to length, time, and mass, taken as indefinables for the dimensions of physical quantities, a fourth indefinable, chosen as electric charge, is necessary for defining electrical and magnetic quantities. For defining thermodynamical quantities, only length, mass,

and time are used, but it is shown that three indefinables are not necessary for measuring the magnitude of mechanical, and hence thermodynamical, quantities, and that these can be adequately defined in terms of length and time only. It is concluded that the choice of indefinables is to some extent arbitrary and there can be no such thing as the abs. dimensions of a quantity. N. M. B.

II.—MOLECULAR STRUCTURE.

λ 3105 band of OD. M. Ishaq (*Proc. Physical Soc.*, 1941, 53, 355—361; cf. A., 1940, I, 401).—The band was photographed in the fourth order of a 10-ft. concave grating, and, like that of OH at λ 3122, is the (1, 1) band of a $^2\Sigma^+ \rightarrow ^2\Pi_{nv}$ transition. A rotational analysis is reported, and the vals. of the rotational consts. are determined and compared with those of the corresponding OH band. N. M. B.

Excitation temperature of the solar reversing layer from CN (3883 Å.). L. Blitzer (*Astrophys. J.*, 1940, 91, 421—427).—The intensities of 14 doublets in the R branch of the 0 \leftarrow 0 band of CN have been measured, and theoretical growth curves for CN computed. The excitation temp. found is $4490 \pm 100^\circ$ K. L. S. T.

Vibrational structure of the $^4\Sigma_g^-(O_2^+) \leftarrow ^3\Sigma_g^-$ Rydberg series of O_2 . Y. Tanaka and T. Takamine (*Physical Rev.*, 1941, [ii], 59, 771).—A study of the far ultra-violet absorption spectrum of O_2 leads to various changes in the classification reported by Price (cf. A., 1936, 1). The strong bands at 732.22, 725.98, and 720.07 Å. are the (0, 0), (1, 0), and (2, 0) bands of the Rydberg series, and the series limits are 146,548, 147,705, and 148,831 cm.⁻¹, respectively. The ionisation potential corresponding with the normal state $b^4\Sigma_g^-$ of O_2^+ is 18.1 ± 0.1 v. N. M. B.

Systematics of band-spectral constants. VI. Interrelation of equilibrium bond constant and internuclear distance. C. H. D. Clark and K. R. Webb. VII. Empirical form of relations involving group number. C. H. D. Clark (*Trans. Faraday Soc.*, 1941, 37, 293—298, 299—302; cf. A., 1940, I, 149).—VI. In relations of the form $k_r r_e^{x+y} = k_{gr}$, involving the equilibrium bond const. k_r , the internuclear distance r_e , and group no. n , good reproduction of data is obtained when $x = 6$, $y = 0.5$ or 1; the most suitable vals. of k_{gr} , a sub-period const., have been assigned. For the di-atom CC empirical data require $x = 5$.

VII. Recent theoretical work supports the above relation and provides evidence in favour of introducing the group no. in the manner indicated. The influence of the assumed potential functions on the val. of the exponents x and y is discussed. F. L. U.

Species classification and rotational energy-level patterns of non-linear triatomic molecules. R. S. Mulliken (*Physical Rev.*, 1941, [ii], 59, 873—889).—Mathematical. The quantised energy levels of symmetrical and asymmetrical tops are discussed from the viewpoint of their classification into symmetry species. These are applied to rotational levels of symmetrical non-linear triat. mols. AB_2 , illustrated by SO_2 . The classification of the over-all wave functions with respect to behaviour for exchange of equal nuclei and for inversion and the resulting level patterns are considered. Rotation-vibration and rotation-electronic perturbations are discussed in relation to the species classification. The concept of gyrovibronic species is introduced and tables of transitions are given. N. M. B.

Fine structure in the far infra-red spectrum of ammonia. H. M. Foley and H. M. Randall (*Physical Rev.*, 1941, [ii], 59, 171—173; cf. A., 1933, 1102).—The pure-rotation absorption spectrum of NH_3 for final state $J = 11, 12, 13, 14, 15$ was examined with high resolution. The multiplet splitting found is expressed by $\nu = 19.89J - 0.00294J^2 + 0.00279/JK^2$, where K is the quantum no. of angular momentum about the symmetry axis. This equation agrees with the theoretical expression of Slawsky (cf. A., 1939, I, 454) when the potential anharmonicities are taken into account. The permanent dipole moment, calc. from the abs. intensity of one absorption, is 1.3×10^{-18} c.g.s. e.s.u. N. M. B.

Atmospheric absorption of infra-red solar radiation at the Lowell observatory. III, IV. Spectral intervals 8.0—11.0 μ . and 11.0—14.0 μ . A. Adel and C. O. Lampland (*Astrophys. J.*, 1940, 91, 481—487; cf. A., 1940, I, 281).—

The transmission of the earth's atm. in the regions 8—11 μ . and 11.0—14.0 μ . has been investigated in its dependence on H_2O vapour, O_3 , and CO_2 . Data are tabulated and curves are given for several liquid H_2O equivs. of atm. H_2O vapour. Absorption by atm. O_3 is much more intense than was formerly supposed. Numerous small absorption lines due to H_2O vapour are recorded. L. S. T.

Ultra-violet absorption spectrum of myosin. M. N. Liubimova and M. S. Schipalov (*Biokhimiya*, 1940, 5, 144—150).—Myosin has a normal protein absorption spectrum (max. at 280 m μ). The coincidence of the spectrum of globulin (hen's egg) with that of myosin of twice the concn. is probably due to the lower content of cyclic amino-acids in myosin. The spectra of mixtures of myosin and adenosine triphosphate result from simple physical overlapping of the two individual spectra. The ultra-violet spectrum of myosin is not affected by inactivation of its adenosine-triphosphatase content by heating to 37° or acidification to pH 4. F. O. H.

Thermodynamic functions of carbon suboxide. H. W. Thompson (*Trans. Faraday Soc.*, 1941, 37, 249—251).—Entropy, free energy, heat content, and sp. heat have been calc. from spectroscopic and structural data for C_3O_2 and are tabulated for the temp. range 279—1000° K. F. L. U.

Thermodynamic functions and equilibria of formaldehyde, deuterioformaldehyde, phosgene, and thiophosgene. H. W. Thompson (*Trans. Faraday Soc.*, 1941, 37, 251—260).—The entropy, free energy, heat content, and sp. heat have been calc. for CH_2O and CD_2O between room temp. and 1500° K., and for $COCl_2$ and $CSCl_2$ between room temp. and 1000° K. The free energy of formation of CH_2O from β -graphite is given for the range 300—1500° K. Calc. vals. of the equilibrium const. for $COCl_2$ are > the measured vals., and the discrepancy is shown to be due to the use of too high a val. for the heat of formation, for which 52.5 kg.-cal. at 291° K. is considered a better val. F. L. U.

Ultra-violet absorption spectra of *N*-phenylpyrazalones. I. Phenylhydrazine. II. Antipyrine, aminoantipyrine, and dimethylaminoantipyrine. N. A. Valjaschko and V. I. Blizniukov (*J. Gen. Chem. Russ.*, 1940, 10, 1280—1299, 1343—1362).—I. The spectra of $NHPh \cdot NH_2$ (I) in H_2O , EtOH, and *n*-hexane are different. The spectra of aq. or EtOH solutions of freshly distilled (I) or of its hydrochloride resemble that of NH_2Ph , suggesting that the hydrazo-structure is the stable form in such solvents. With time, the spectra of solutions in EtOH change, and become similar to that of *anti*- PhN_2K ; this change is prevented or reversed by HCl. The results suggest resonance between diazo- and hydrazo-structures of (I).

II. The spectra of 1-phenyl-2:3-dimethylpyrazol-5-one (II) and its 4- NH_2 - and 4- NEt_2 -derivatives in H_2O , EtOH, and *n*-hexane resemble those of (I), in that they include bands typical of the diazo- and hydrazo-structures of (I), and are similarly modified by HCl. In 5*N*-HCl in EtOH the spectra are identical with those of 5-chloro-1-phenyl-2:3-dimethylpyrazole 2-methochloride or its 4- NH_2 - or 4- NEt_2 -derivatives, and resemble that of 1:2:3-trimethylpyrazol-5-one. (II) and its amino-derivatives are unaffected by NaOEt in EtOH. R. T.

Structural studies on natural and artificial yttrifluorite using fluorescence and absorption spectra. N. Chatterjee (*Z. Krist.*, 1939, 102, 245—284; cf. A., 1939, I, 451).—Yttrifluorite (I) has been compared with artificial $CaF_2 \cdot YF_3$ phosphors containing 1—100% (p%) of YF_3 contaminated with rare-earth fluorides. Data are given for the infra-red absorption spectra at -180° and fluorescence spectra (excited by light and cathode rays) at 20° and -180° . As p increases a progressive replacement of Ca^{++} by Y^{+++} in the CaF_2 lattice causes a weakening of the linkings and increasing diffusiveness of the spectrum lines. With $p = \sim 50$ —95 the preps. are mixtures; Debye-Scherrer photographs show that two and three cryst. species, respectively, are present with $p = \sim 70$ —80 and 80—90. Mixed crystals with the YF_3 structure occur with $p > 95$. (I) has a homogeneous cubic lattice with $p = 14$; it differs slightly from the corresponding artificial product owing to differences in the rare-earth contents, and to lattice tensions and non-uniformity of the distribution of ions in the artificial preps. A. J. E. W.

Photoluminescence of solutions of thallium salts. B. E. Gordon and A. A. Schischlovski (*Acta Physicochim. U.R.S.S.*,

1940, 13, 247—264).—In continuation of earlier experiments (cf. A., 1940, I, 66), the photoluminescence of solutions of TI salts and the effect of concn. and the addition of anions and cations have been investigated. The emission centre is apparently TI'. Photoluminescence is quenched by OH' and halide ions, possibly as a result of the formation of complexes of TI' and added ion. C. R. H.

Luminescent materials. III. Photo-conductivity and molecular vibration structure of the fluorescence spectra of zinc sulphide crystal phosphors. Y. Uehara (*Bull. Chem. Soc. Japan*, 1941, 16, 99—105).—The view that the fluorescence of ZnS phosphors is due to resonance radiation in the activation centres leads to a calculation of the photo-conductivity of ZnS in approx. agreement with observation, and to the prediction, which is verified experimentally, that the mol. vibration structure of ZnS should be observed in the fluorescence spectrum. F. J. G.

Temperature variation of the Raman frequency of diamond. P. G. N. Nayar (*Proc. Indian Acad. Sci.*, 1941, A, 13, 284—290).—The Raman frequency of diamond varies from 1333.8 cm^{-1} at -190° to 1316.4 cm^{-1} at 860° . The rate of decrease of frequency rises with increasing temp. This variation exceeds that expected from the thermodynamical relation between the thermal expansion of the crystal and the change in characteristic frequency. The large change may be because the 1332 cm^{-1} line is the lattice oscillation which causes the diamond-graphite transition. This agrees with work on quartz, when the oscillations responsible for polymorphic transition show changes of frequency even at comparatively low temp. (Nedungadi, A., 1940, I, 243). A. J. M.

Raman spectrum and specific heat of crystalline sulphur. R. Norris (*Proc. Indian Acad. Sci.*, 1941, A, 13, 291—299).—Raman spectra of a single crystal of S with different orientations of the crystal, and with incident light of different degrees of polarisation, have been obtained. A new line with a frequency shift of 50 cm^{-1} has been recorded. The fundamental frequencies are identified. The sp. heat of S at different temp. calc. from Raman data agrees satisfactorily with observed vals. A. J. M.

Raman spectra of aldehyde and ketone bisulphites. C. N. Caughlan and H. V. Tartar (*J. Amer. Chem. Soc.*, 1941, 63, 1265—1267).—The Raman spectra of aq. solutions of the additive compounds between NaHSO_3 and CH_3O , MeCHO , EtCHO , Pr^nCHO , and COMe_2 are recorded. They indicate the existence of a C—S linking. The multimol. formula is incorrect. W. R. A.

Raman effect of oxonium compounds. A. Gantmacher, M. Volkenstein, and J. Sirkin (*Acta Physicochim. U.R.S.S.*, 1941, 14, 157—184).—Raman spectra of mixtures of Me_2O with HCl in the mol. ratios 1 : 1, 1 : 2, and 1 : 3 were studied at 20° , -20° , -40° , and -80° . In the 1 : 1 mixture there is a shift in the Me_2O frequencies, and the frequency due to HCl is absent. In the 1 : 2 and 1 : 3 mixtures there is a still greater shift in the Me_2O frequencies, whilst new frequencies appear at 500 cm^{-1} and 2400 cm^{-1} , the latter being the centre of a broad diffuse band. The broad band is attributed to strongly deformed HCl, whilst the frequency 500 cm^{-1} is interpreted in the same way as the corresponding intermol. frequency of liquid H_2O . The data of Briegleb and Lauppe (cf. A., 1937, I, 599) are analysed and their interpretation criticised. Raman spectra of solutions of ethers and alcohols in excess of H halide are consistent with the formation of H bonds and afford no satisfactory evidence of a structure with O^+H . F. L. U.

Raman spectra of halogen derivatives of ethylene and electronic resonance. E. Prileshaeva, J. Sirkin, and M. Volkenstein (*Acta Physicochim. U.R.S.S.*, 1941, 14, 119—153).—Raman spectra have been recorded for $(\text{CBr}_2)_2$, $\text{CHBr}:\text{CBr}_2$, $\text{CMe}_2:\text{CCl}_2$, $\text{CHPh}:\text{CCl}_2$, and $\text{CHPh}:\text{CBr}_2$, and a partial assignment of modes of vibration is given. The presence of a halogen atom on one or both of the doubly-linked C atoms markedly lowers the frequency of the C:C linking, whereas the presence of halogen on an adjacent C has a much smaller effect. The influence of mass is not sufficient to account for the effect, which must be due to the contribution of resonance structures with ter-covalent C. Published data on Raman spectra of other unsaturated compounds and also on interat. distances and dipole moments are compared so as to show the effects of mass and of resonance, in conjunction with theoretical calculations. F. J. G.

Relation between conductivity and emission characteristics of caesium oxide cathodes. P. G. Borzjak (*Physical Trans. Ukrain. Acad. Sci.*, 1940, 9, 3—18).—Two Pt strips were fixed on glass, and a transparent layer of Cs was condensed on the strips and the glass surface between them and then partly oxidised. The amount of Cs in this cell was gradually reduced by heating to 170 — 240° and freezing out Cs vapour. After each heating and cooling the conductivity κ of the Cs—Cs₂O layer between the Pt electrodes, the photo-electric current i , and the coeff. δ of the secondary emission were measured. κ decreased regularly, and i and δ passed through a max., as the no. of heating cycles increased, the max. of δ being reached always later than that of i . Near the max. of i the magnitude of κ was still so high that the fatigue of photo-cathodes could not be ascribed to a shortage of electrons. At high temp. (125 — 165°), [Cs] being kept low and const., κ was much higher and δ slightly higher. Secondary emission is no definite function of [Cs] and appears to be chiefly due to Cs₂O. Some experiments on thermionic emission of Cs—Cs₂O cathodes are reported. J. J. B.

Electrical contact resistance. G. Windred (*J. Franklin Inst.*, 1941, 231, 547—585).—Two conditions determining contact resistance are reviewed. The theory is outlined, and the effect of surface films is considered. Coherer action is discussed, and the experimental work is reviewed.

Conduction of electricity by dielectric liquids at high field strengths. H. J. Plumley (*Physical Rev.*, 1941, [ii], 59, 200—207).—The conductivity of highly purified heptane was measured between optical flats at field strengths up to 600,000 v. per cm. at temp. -190° to 20° . It is concluded that electronic or collision processes are unlikely as the source of high field conductivity in heptane and most other liquid dielectrics. It is suggested that the highly non-conducting dielectric liquids should be included as extreme cases in the general class of weak electrolytes. The presence of appreciable conductivity under high electric fields is ascribed to the lowering of the energy of the H bond by the applied field. N. M. B.

Electric moments of the mercuric halides in dioxan. B. C. Curran (*J. Amer. Chem. Soc.*, 1941, 63, 1470—1471).—Correction to previous data (A., 1936, 12). W. R. A.

Steric inhibition of resonance in aromatic carbonyl compounds. R. G. Kadesch and S. W. Weller (*J. Amer. Chem. Soc.*, 1941, 63, 1310—1314).—The inhibition of resonance in compounds of the COPhR type involving quinonoid structures, by the introduction of two Me in the *o*-position, has been investigated at 25° by dipole moment measurements (cf. A., 1937, II, 92) of COPhMe, acetylmesitylene, acetyldurene, PhCHO, mesitaldehyde, BzCl, 2 : 4 : 6 : 1-C₆H₂Me₃:COCl, and COPh₂. The inhibition is steric, the *o*-Me preventing the formation of the coplanar configuration required for the quinonoid structure. The effect is absent if R represents H, but readily observed when R is Me or Cl. W. R. A.

Dipole moments and molecular structure of diphenylene dioxide and phenoxthrin. K. Higasi (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, 38, 331—340).—At 25° vals. of μ are (solvent in parenthesis): diphenylene dioxide (I) 0.64 (C₆H₆), 0.57 (C₆H₅); 2 : 6-dimethyl-0.61 (C₆H₆), and 2 : 6-dichloro-diphenylene dioxide 0.62 (C₆H₆); phenoxthrin (II) 1.09 (C₆H₆ and C₆H₅) *p*. Both (I) and (II) have folded configurations about the O—O or O—S axes, which are so flexible that optical isomerides cannot exist. W. R. A.

Dipole moments of aromatic sulpho-compounds. E. N. Gurjanova (*Acta Physicochim. U.R.S.S.*, 1941, 14, 154—155).—Vals. of $\mu \times 10^{18}$ (in C₆H₆ or dioxan) are recorded as follows: PhSO₃H, 3.77; PhSO₂Cl, 4.54; PhSO₂NH₂, 4.75; *p*-C₆H₄MeSO₂Cl, 5.01; *p*-C₆H₄MeSO₂NH₂, 5.02; *m*-NO₂C₆H₄SO₂Cl, 4.12; *p*-NH₂C₆H₄SO₂NH₂, 6.60; 4 : 1 : 2-NO₂C₆H₃MeSO₂NH₂, 4.51; 4 : 1 : 2-NO₂C₆H₃MeSO₂Cl, 4.85; *m*-CO₂H-C₆H₄SO₂Cl, 3.85; 2-C₁₀H₇SO₂NH₂, 5.36; 2-C₁₀H₇SO₂Cl, 4.98; 1-C₁₀H₇SO₂NH₂, 5.14; 1 : 5-C₁₀H₇(SO₂Cl)₂, 1.66. F. J. G.

Optical refraction patterns. I. Theory. R. S. Rivlin (*Proc. Physical Soc.*, 1941, 53, 409—417; cf. A., 1941, I, 132).—Mathematical. A theory is developed for the formation of patterns by refraction of light by a rough plane surface when a point source of light is viewed through this surface. Formulae are deduced and curves are given showing the relation between the intensity distribution in the refraction

pattern formed by a surface uniformly covered by small facets, having any specified distribution of orientations, and this distribution of orientations. From a measurement of light-intensity distribution in the refraction pattern, the law of facet distribution with orientation may be calc.

N. M. B.

Polarising properties of dyed Cellophane films. S. Silverman (*Rev. Sci. Instr.*, 1941, 12, 212; cf. A., 1940, I, 235).—The polarising properties are shown when dichroic dyes are absorbed by the film and assume the spatial pattern of the base cellulose. The degree of orientation of the cellulose mols. in the film may be calc. from the equation % orientation = $(D_1 - D_2)/(D_1 + 2D_2)$ where D_1 and D_2 are the optical densities for light vibrating parallel and perpendicular, respectively, to the direction of extrusion of the film during manufacture. Transmittance curves are given for du Pont light green Cellophane and indicate an orientation of 16%.

D. F. R.

Co-ordination structure and chemical properties of hydrides of boron. B. V. Nekrasov (*J. Gen. Chem. Russ.*, 1940, 10, 1156—1166).—The properties of hydrides of B are best explained on the assumption that they are co-ordination compounds.

R. T.

Inductive effect. J. Sirkin and M. Diatkina (*Acta Physicochim. U.R.S.S.*, 1941, 14, 185—192).—The influence of substituents on the distribution of charges in org. compounds is treated as an effect of resonance with stabilised ionic structures. A quant. examination of the energies of such structures is made for NPhMe_3^+ and PhCl , and the directing influence of these substituents is shown to follow from the assumptions made. PhSO_3H , PhMe , and PhNO_2 are also discussed.

F. L. U.

Binding energy of molecules with localised bonds. M. F. Mamontenko (*Acta Physicochim. U.R.S.S.*, 1941, 14, 287—293).—Mathematical. The approximations involved in the derivation of Slater's formula (cf. A., 1931, 1356) lead to the exchange energy being overrated by a factor of 1.5 if the exchange integrals are calc. analytically. If, however, they are obtained from spectroscopic or thermochemical data calculations from the formula may be legitimate. By taking into account all possible single and simultaneous permutations of electrons, taken two at a time, an expression for the binding energy of a mol. is derived which is but little more complicated than Slater's formula.

F. L. U.

Structure of the naphthalene molecule. J. Sirkin and M. Diatkina (*Acta Physicochim. U.R.S.S.*, 1941, 14, 105—118).—The results of the quantum-mechanical calculations of Sherman (A., 1934, 1159) are used to interpret many of the peculiarities of C_{10}H_8 and its derivatives, especially in regard to substitution and hydrogenation.

F. J. G.

Orientation of molecules of anisotropic liquids during streaming. V. Zvetkov and V. Marinin (*Acta Physicochim. U.R.S.S.*, 1940, 13, 219—240).—Theoretical. Data for the influence of magnetic fields on the dielectric properties of liquids can be explained by assuming the presence of ellipsoidal swarms which are large enough for the Brownian effect to be neglected and which are restricted in their free rotatory movement by the orienting fields of the swarm complex.

C. R. H.

Paramagnetic relaxation and the equilibrium of lattice oscillators. J. H. Van Vleck (*Physical Rev.*, 1941, [ii], 59, 724—729; cf. A., 1940, I, 200, 312).—It is shown that the conventional models of paramagnetic relaxation cannot be used at He temp., since the lattice vibrations cannot serve as a thermostat in the way ordinarily supposed.

N. M. B.

Energy exchange between lattice oscillators. J. H. Van Vleck (*Physical Rev.*, 1941, [ii], 59, 730—736; cf. preceding abstract).—Mathematical. The rate of transfer of energy between lattice oscillators due to anharmonic perturbations is calc. when different portions of the frequency spectrum are not in thermal equilibrium. This transfer is distinguished from thermal conductivity, and the mean free paths for the two problems are shown to be unrelated. It is found that the rate of flow of energy between a band of low-frequency oscillators and the main body of lattice vibrations $\propto T^4$ at low temp., and the corresponding collision frequency between oscillators is $\sim 10^5$ per sec.

N. M. B.

Properties of ions. V. Simplest form of equation for crystal lattice energy. B. V. Nekrasov (*J. Gen. Chem. Russ.*,

1940, 10, 1393—1394).—The crystal lattice energy of a compound K_xA_y is expressed by V kg.-cal. per g.-equiv. = $256(V_K + V_A)/(r_K + r_A)$, where V_K and V_A are the valencies of the cation and anion, respectively, and r_K and r_A are the ionic radii.

R. T.

Molecular volume and structure. I, II. T. W. Gibling (*J.C.S.*, 1941, 299—304, 304—309).—I. It is suggested that at. and structural parachors should be replaced by group vals. The change in $[P]$ produced by the addition of CH_2 shows a progressive increase throughout any homologous series, excepting among the earlier members where decreases due to "interference effects" are found. For normal hydrocarbons $[P] = [2c + (n - 2)h]f^n$, where c (= 55.2) and h (= 39.8) are the effective contributions by CH_3 and CH_2 , respectively, and f (= 1.0004165) is an "expansion factor." Standard vals. are allotted to the groups present in branched-chain and unsaturated hydrocarbons, and "interference reductions" are assessed.

II. Reductions in $[P]$ produced by bent chains and the allotments of $[P]$ vals. to groups involving linkings with O atoms are discussed with reference to hydrocarbons, alkyl ethers, and esters. In compounds containing a CO group $[P]$ reductions are found, apparently because the polarity of these mols. causes interaction between this group and neighbouring groups. Glyceryl esters, dialkyl carbonates, and dialkyl malonates show further diminutions in $[P]$, suggesting the existence of closely packed parallel chains of C atoms in these mols.

J. W. S.

Surface tension and angle of contact of a liquid. A. E. Bate (*Proc. Physical Soc.*, 1941, 53, 403—409).—The theory is based on the large sessile drop. Expressions derived are $h^2 + d^2 = 4a^2(1 + 2a/3r)$ and $\cos \theta = (d^2 - h^2)/(d^2 + h^2)$, where h is the height of a drop of the liquid, d is the depth of a bubble formed in the liquid beneath a horizontal plane; $a^2 = \gamma/g\rho$, where γ is the surface tension, and r is the horizontal radii of the drop and bubble, assumed to be the same and < 6 cm. in length. The first expression is independent of the angle of contact θ , and the second is independent of γ and the density ρ of the liquid. The methods of developing the drop and bubble and of measuring h and d are described. Preliminary experiments indicate that C_6H_6 and H_2O have definite θ with plate glass.

N. M. B.

Boundary tension of gallium. G. L. Mack, J. K. Davis, and F. E. Bartell (*J. Physical Chem.*, 1941, 45, 846—851).—The surface tension of Ga in H_2 or CO_2 is 735 ± 20 dynes per cm. between 30° and 40° . The interfacial tension against 0.1N- and 0.2N-HCl is 636 ± 2.6 dynes per cm. at 35° .

C. R. H.

Parachor of diborane. G. N. Copley (*Chem. and Ind.*, 1941, 537—539).—"Isosteric" $[P]$ vals. (cf. A., 1941, I, 431) are calc. for several suggested structures for B_2H_6 . Agreement with the observed val. (121.9, cf. Stock *et al.*, A., 1937, I, 93) is given by a mesomeric structure (cf. Bauer, *ibid.*, 397), four phases of which have $[P]$ (isosteric) = $125.1 - 129.9$.

A. J. E. W.

Uniform atmospheric dispersion of the rare gases. S. Bull (*Stereochem.*, 1939, 3, 17—20).—Speculative.

W. J.

The diamond molecule. S. Bull (*Stereochem.*, 1939, 3, 20, 32).—Speculative.

W. J.

III.—CRYSTAL STRUCTURE.

Diffuse X-ray diffraction maxima. W. H. Zachariasen (*Physical Rev.*, 1941, [ii], 59, 207—208).—Remeasurement of the photographs of Raman and Nilakantan (cf. A., 1940, I, 431) disproves the assertion by these authors that the theory of diffuse scattering (cf. *ibid.*, 285) does not give the correct positions of the diffuse max., and that the effect is not a diffuse scattering phenomenon.

N. M. B.

Temperature diffuse scattering. W. H. Zachariasen (*Physical Rev.*, 1941, [ii], 59, 766; cf. A., 1940, I, 285).—A crit. discussion of Jauncey's explanation (cf. A., 1941, I, 245) of the max. of the temp. diffuse scattering on the assumption that thermal agitation breaks up the crystal lattice into small groups of atoms. The physical picture is not supported but the assumption gives the approx. positions of the diffuse max.

N. M. B.

Non-Laue maxima in the diffraction of X-rays from rock-salt. Equatorial maxima. G. E. M. Jauncey and O. J. Baltzer (*Physical Rev.*, 1941, [ii], 59, 699—705).—Available observations and theory are reviewed. Cu K α , Cu K β , and Mo K α X-rays with a weak continuous background were diffracted from an etched cleavage face of a thin rock-salt crystal. With the crystal face turned by 1° steps from a glancing angle of 45° 7' to 28° 7' the positions of the non-Laue max. associated with the 400 and 620 Bragg reflexions were found. All photographs showed a shift >0 for the max. intensity of the non-Laue spot from the position of the corresponding Bragg spectrum line. Results differ from those of Raman (cf. A., 1940, I, 348, 431) and from Zachariasen's theoretical val. (cf. *ibid.*, 285). The shortest effective λ of the elastic waves concerned are ~ 13 —17 Å.; or 2—3 times the min. λ in Debye's sp. heat theory. N. M. B.

Non-Laue diffraction maxima from rock-salt. Non-equatorial maxima. G. E. M. Jauncey, O. J. Baltzer, and D. C. Miller (*Physical Rev.*, 1941, [ii], 59, 908—909; cf. preceding abstract).—Corrections are given for the experimental positions of the non-equatorial associated Bragg spots, and for the calc. positions as found from Zachariasen's revised formula (cf. following abstract). Good agreement is obtained. N. M. B.

Temperature diffuse scattering maxima for rock-salt. W. H. Zachariasen (*Physical Rev.*, 1941, [ii], 59, 909).—Positions of max. calc. by a revised formula (cf. following abstract) show good agreement with experiment (cf. preceding abstract). N. M. B.

Temperature diffuse scattering of a simple cubic lattice. W. H. Zachariasen (*Physical Rev.*, 1941, [ii], 59, 860—866; cf. A., 1940, I, 285).—Mathematical. The necessary propagation velocities and polarisation directions are found for a simple cubic lattice of the Born-Kármán type. When the elastic const. satisfy the condition $c_{11} = 3c_{12}$ the formula for the intensity distribution in the diffraction max. is very simple. Expressions for the positions and half-widths of the intensity max. are developed. For $c_{11} \gg 3c_{12}$ (treated in detail) the diffuse diffraction max. have a complex structure, each max. consisting, in general, of three peaks. Formulae for the position and intensity of these peaks are given. An intensity expression for very small scattering angles is developed. N. M. B.

X-Ray diffraction in random layer lattices. B. E. Warren (*Physical Rev.*, 1941, [ii], 59, 693—698).—Mathematical. Lattice structures consisting of layers parallel and equidistant, but random in translation parallel to the layer, and rotation about the normal, are considered. Equations are developed for the intensity distribution in a two-dimensional powder reflexion, for the integrated intensity, for the particle size in terms of peak breadth, and for the displacement of the peak. The powder pattern of a heat-treated C-black is given as an illustration of two-dimensional lattice reflexions. N. M. B.

Crystal lattice models based on the close packing of spheres. A. L. Patterson (*Rev. Sci. Instr.*, 1941, 12, 206—211; cf. A., 1941, I, 7).—For the case in which spheres occupy the lattice points of a space lattice there are 15 types of packing differing from one another either in symmetry or in the no. of contacts a given sphere makes with its neighbours. The types include 10 of the 14 Bravais lattices. The lattice close packing may be used as a basis for models of more complex structure. D. F. R.

Applications of X-ray technique to the study of preferred orientation of crystals in metals. T. L. Richards (*J. Sci. Instr.*, 1941, 18, 150—152).—Methods are discussed. The preferred orientation of crystals is best represented by pole figures. A. A. E.

X-Ray diffraction and the deformation of metals. W. A. Wood (*J. Sci. Instr.*, 1941, 18, 153—154).—A brief review of changes revealed by X-ray studies. A. A. E.

Applications of X-ray methods in the examination of organic crystals. A. Hargreaves and W. H. Taylor (*J. Sci. Instr.*, 1941, 18, 138—144).—The nature of the information obtainable is discussed. X-Ray investigation shows that in calycanine the unit cell appears to have a 13.7, b 4.45, c 9.7 Å. (all ± 0.1 Å.), β $107 \pm 2^\circ$, and contains 2 mols. of $C_{14}H_{10}N_2$; space-group $P2_1/a-C_{2h}$. When weak reflexions are taken into account, however, the true c -axis is of length 2×9.7 Å.

and the unit cell contains 4 mols. Of the possible formulae, only (I) approximates closely to centro-symmetry if C and N atoms, having nearly identical scattering powers for X-rays, are supposed indistinguishable. Other crystallographic evidence supports this view. *m*-Tolidine dihydrochloride has a 4.98 ± 0.02 , b 6.18 ± 0.03 , c 23.3 ± 0.1 Å., β $91 \pm 0.5^\circ$; the unit cell contains 2 mols.; space-group $I2-C_2$. Hence the *m*-tolidine mol. cannot be planar, whilst benzidine and *o*-tolidine mols. may be planar. Electron-density contours indicate that in *m*-tolidine the angle between the planes of the Ph rings is 73° ; the length of the uniting C_1-C_1' bond is 1.51 Å. The mean C—C distance in the C_6H_5 ring is 1.38 Å.; the significance of irregularities is considered. In the dihydrochloride each Cl atom is in contact with 4 N atoms of different mols. at distances 3.25, 3.25, 3.32, 3.13 Å., and is probably present as Cl' . Hence the *m*-tolidine mols. are held in position by strong bonds which fix the terminal N, accounting for the abnormal hardness of the crystal and for other properties. A. A. E.

“Form,” “fashion,” and “habit” concepts in crystal morphology. W. Nowacki (*Z. Krist.*, 1939, 102, 144—145).—“Form” (“Gestalt”) should refer to the spatial distribution of the edges of the crystal polyhedron, without reference to the relative extent of their development. “Fashion” (“Tracht”) should indicate the combination of crystallographic forms present in the crystal, “habit” (“Habitus”) denoting the relative degree of development of those forms. A. J. E. W.

Modified reflexion of X-rays: naphthalene. S. Bhagavantam and J. Bhimasenachar (*Proc. Indian Acad. Sci.*, 1941, A, 13, 266—268).—The modified reflexion of X-rays described by Raman *et al.* (A., 1941, I, 30) was observed with $C_{10}H_8$ from the (001), (002), and (201) planes when the crystal setting was very near the crit. setting for the particular plane. For orientations differing widely from these the intensity of modified spots is very low. This is in contrast to the effect with inorg. crystals, where the modified spots have been obtained at fairly large angles. A. J. M.

Crystallographic studies of the perchlorates of the three bases 1-dimethylamino-6-hydroxy- (base I), 6-dimethylamino-1-hydroxy-dihydrocarvone (base II), and 6-dimethylaminocarbonyl (base III). O. Grütter (*Z. Krist.*, 1939, 102, 48—59).—Morphological, optical, and goniometric data are recorded. The perchlorates of bases (I), (II), and (III) are monoclinic, monoclinic with pseudo-rhombic to tetragonal symmetry, and rhombic, respectively. Rupe and Gysin's conclusions as to the structure of (III) (cf. A., 1939, II, 71) are verified by a closer crystallographic relationship to (II) than to (I). A. J. E. W.

Crystal structure of succinic acid. H. J. Verweel and C. H. MacGillivray (*Z. Krist.*, 1939, 102, 60—70).—A detailed account of work already noted (A., 1938, I, 441). At. parameters are determined by Patterson and Fourier syntheses; the structure proposed by Yardley (A., 1924, ii, 382) is not confirmed. The C—C linkings are of the single aliphatic type. The mol. is not quite flat, the CO_2H groups being turned $\sim 11^\circ$ out of the plane of the C atoms. A. J. E. W.

Crystal structure of bromanil. S. L. Chorghade (*Z. Krist.*, 1939, 102, 112—118).— $C_6O_2Br_3$ has a 8.62, b 6.22, c 17.94 Å., β 102° ($a:b:c = 1.386:1.2:0.884$); 4 mols. per unit cell. Indexed visually-estimated intensities in oscillation photographs about the a - and c -axes are tabulated; if the observed halvings are real the space-group is $C_{2h}^2-B2_1/c$, but certain absences ($h+1$ odd) may be due to absorption, in which case the true space-group is $C_{2h}^2-P2_1/a$. As in chloranil (cf. A., 1941, I, 155), (201) is a plane of approx. symmetry which renders the structure pseudo-orthorhombic. A. J. E. W.

Crystal structure of lithium hydroxide monohydrate. R. Pepinsky (*Z. Krist.*, 1939, 102, 119—131).— $LiOH \cdot H_2O$ has a 7.37, b 8.26, c 3.19 Å., β $110^\circ 18'$ ($a:b:c = 0.892:1:0.386$); 4 mols. per unit cell; ρ_{obs} , 1.51; space-group C_{2h}^2-C2/m . At. parameters are derived from a consideration of the distribution of O linkings, and by Fourier analysis. Each Li lies at the centre of a tetrahedron of O atoms; two such tetrahedra share an edge, formed by two O from OH -groups, which lies in a reflexion plane and at an angle of 12.5° with the a -axis. Upper and lower corners of the tetrahedra (O from

H_2O) are shared with tetrahedra above and below; the edges between the shared corners and the chains of tetrahedra are parallel to the c -axis. The chains are joined laterally by OH-linkings between OH and H_2O . The structure is compared with those of Li_2O (Zintl *et al.*, A., 1934, 1059) and LiOH (Ernst, A., 1933, 341). A. J. E. W.

Crystal structure of the tetragonal monoxides of lead, tin, palladium, and platinum. W. J. Moore, jun., and L. Pauling (*J. Amer. Chem. Soc.*, 1941, 63, 1392–1394).—The structure of tetragonal PbO , from X-ray powder photographs, is that assigned by Dickinson and Friauf (A., 1925, i, 18) and not that given by Levi and Natta (*Nuovo Cim.*, 1926, 3, 114). The structure of SnO is similar to that of PbO , space-group $P4/nmm$, 2 O at 000, $\frac{1}{2}\frac{1}{2}\frac{1}{2}$, 2 Pb (Sn) at $\frac{1}{2}\frac{1}{2}\frac{1}{2}$, $0\frac{1}{2}\frac{1}{2}$. The tetragonal PdO and PtO have space group $P4/mnc$, 2 O at $\frac{1}{2}\frac{1}{2}\frac{1}{2}$, $0\frac{1}{2}\frac{1}{2}$, 2 Pd (Pt) at 000, $\frac{1}{2}\frac{1}{2}\frac{1}{2}$, and the metal forms a coplanar rectangular co-ordination group. Vals. of parameters for PbO , SnO , PdO , and PtO are respectively: a_0 3.947 ± 0.006 , 3.796 ± 0.006 , 3.02 ± 0.01 , 3.04 ± 0.03 ; c_0 4.988 ± 0.008 , 4.816 ± 0.008 , 5.31 ± 0.01 , 5.34 ± 0.05 ; z 0.2386 ± 0.0011 (PbO), 0.2356 ± 0.0019 (SnO) A. W. R. A.

Structures of methyl borate and trimethyl triborine trioxane. Interatomic distances in boron compounds. S. H. Bauer and J. Y. Beach (*J. Amer. Chem. Soc.*, 1941, 63, 1394–1403).—Electron diffraction investigation of $\text{B}(\text{OMe})_3$ and $(\text{B}(\text{OMe})_3)_n$ lead to the following structures: $\text{B}(\text{OMe})_3$ has a planar BO_3 group with $\text{B}-\text{O}$ 1.38 ± 0.02 , $\text{O}-\text{C}$ 1.43 ± 0.03 A., $\text{B}-\text{O}-\text{C}$ angle $113 \pm 3^\circ$, and rotation of OMe around $\text{B}-\text{O}$ linkings; $(\text{B}(\text{OMe})_3)_n$ has a planar 6-membered ring with alternate B and O, Me linked to B and in the plane of the ring, $\text{B}-\text{O}$ 1.39 ± 0.02 , $\text{O}-\text{C}$ 1.57 ± 0.03 A., $\text{B}-\text{O}-\text{B}$ angle $112 \pm 4^\circ$. The method of Schomaker and Stevenson (A., 1941, I, 100) has been extended to B compounds and the calc. single covalent radius of B is $0.83-0.84$ A., which with the val. of 0.86 A. deduced from the spectroscopically determined $\text{B}-\text{H}$ distance, gives a preferred val. of 0.85 A. This val. has been used to compute single bond distances for various elements attached to B and these are compared with observed vals. W. R. A.

Effect of temperature and concentration of sodium hydroxide on the X-ray diffraction behaviour of raw and of degraded cotton. W. A. Sisson and W. R. Saner (*J. Physical Chem.*, 1941, 45, 717–730).—The effect of NaOH on the X-ray diagrams of raw, purified, acid-treated, and mechanically ground cotton has been investigated. Raw and purified cottons give similar diagrams. Complete mercerisation takes place in 13–14% NaOH at 20° , and as the temp. is lowered the $[\text{NaOH}]$ necessary for complete mercerisation is lowered, being 5% at -18° . At higher temp. ($\sim 65^\circ$) only partial mercerisation takes place in 16–50% NaOH . At low temp. and high $[\text{NaOH}]$ partial or no mercerisation occurs, owing possibly to the formation of NaOH hydrates which are too large to enter the cryst. cellulose lattice. When completely mercerised cotton is heated a certain amount of reversion to the native state takes place. In a partly mercerised cotton the native and mercerised cottons exist as two separate cryst. phases, but there is less distinction between the two phases where reversion has occurred. Acid-treated cotton is mercerised over wider temp. and $[\text{NaOH}]$ ranges than is raw cotton. The temp. and $[\text{NaOH}]$ ranges over which complete mercerisation of ground cotton occurs widen as the particle size diminishes. The mechanism of mercerisation is discussed. C. R. H.

Starch molecule. G. V. Caesar and M. L. Cushing (*J. Physical Chem.*, 1941, 45, 776–790).—Literature dealing with the structure, length, and spatial configuration of the amylose mol. is reviewed. Photographs of Fisher-Hirschfelder at. models of d -glucose, amylose, and cellulose are reproduced. The model of amylose yields a helical spring configuration with the springs twisted around one another to form a sort of rope micelle, an arrangement which is considered to be in accord with the physical and chemical properties of starch and its aq. dispersions and with its behaviour on retrogradation. C. R. H.

Magnetic anisotropy of gadolinium sulphate octahydrate. K. S. Krishnan and S. Banerjee (*Physical Rev.*, 1941, [ii], 59, 770; cf. A., 1939, I, 361).—Measurements on a specimen of known purity are reported. Denoting the max. and min. susceptibilities in the (010) plane by χ_1 and χ_2 , respectively, and the susceptibility along the b axis by χ_3 , at room temp.

$\chi_1 - \chi_2 = 36 \times 10^{-6}$, $\chi_3 - \chi_1 = 16 \times 10^{-6}$, $\chi = (\chi_1 + \chi_2 + \chi_3)/3 = 52,000 \times 10^{-6}$ e.m.u. The χ_1 axis makes an angle of $\sim 17^\circ$ with c and 45° with a . The difference, $\chi_3 - \chi_2$, between the extreme susceptibilities is 52×10^{-6} , or only 0.1% of the mean susceptibility compared with 1.4% previously reported. This val. of the anisotropy corresponds with a separation of ~ 0.2 cm. $^{-1}$ between the adjacent levels in the Stark pattern of the ^8S state of Gd^{+++} , or of the same order as expected from demagnetisation and sp. heat measurements at low temp. N. M. B.

Torque on a ferromagnetic single crystal in a magnetic field. R. M. Bozorth and H. J. Williams (*Physical Rev.*, 1941, [ii], 59, 827–833).—An anomalous max. found by Tarasov (cf. A., 1940, I, 101) in the torque exerted on a disc cut from a ferromagnetic cubic crystal, for one orientation, in a magnetic field is confirmed, and a similar effect is observed for a series of orientations of discs cut parallel to the (110) and (100) planes. The anomaly is explained in terms of the domain theory which predicts a max. in the torque-field strength curve for most crystal orientations provided the demagnetising factor of the specimen is small. A graphical method for calculating torque and magnetisation curves for any direction of the applied field is described. N. M. B.

High magnetic saturation value for the copper-manganese-tin Heusler alloy, Cu_2MnSn . L. A. Carapella and R. R. Hultgren (*Physical Rev.*, 1941, [ii], 59, 905).—The alloy has $I_0 = 660$ ergs/gauss/c.c. or 4.14 Bohr magnetons per Cu_2MnSn group compared with 3.15 for Cu_2MnAl . The substitution of Sn for Al has increased the lattice const., and hence the corresponding at. spacings, by $\sim 4\%$ and the magnetisability by 19%. Explanations of the high val. are discussed. N. M. B.

Electric breakdown of glasses and crystals as a function of temperature. A. von Hippel and R. J. Maurer (*Physical Rev.*, 1941, [ii], 59, 820–823; cf. A., 1940, I, 14; Austen, *ibid.*, 434).—The effect of order and disorder is investigated. The dielectric strength of the alkali halide crystals increases steeply with temp. in the lower temp. range, but the opposite trend is found in glasses. Comparison of the characteristics of SiO_2 glass with quartz confirms that the positive temp. coeff. of the dielectric strength is produced by the periodic structure of the crystals, and the abs. val. of the breakdown strength is appreciably increased in the disordered amorphous state. The influence of temp. and structure on the scattering of electrons gives a partial explanation. N. M. B.

Scattering, trapping, and release of electrons in sodium chloride and in mixed crystals of sodium chloride and silver chloride. A. von Hippel and G. M. Lee (*Physical Rev.*, 1941, [ii], 59, 824–826; cf. preceding abstract).—The steep decrease with temp. in the higher temp. range of the dielectric strength of the alkali halide crystals (cf. A., 1940, I, 14) cannot be explained by thermal breakdown, but indicates a new mechanism which is investigated in rock-salt and mixed crystals of NaCl and AgCl . Observed facts can be explained by assuming that the intensity of the electron avalanches is decisively influenced by trapping of secondary electrons in the lattice and their release by heat vibrations. New spectroscopic evidence for the trapping mechanism is given. N. M. B.

Elastic constants of α -quartz. A. W. Lawson (*Physical Rev.*, 1941, [ii], 59, 838–839).—Mathematical. The results of Atanasoff (cf. A., 1941, I, 105) show a small discrepancy with the classical elastic theory for substances having the symmetry of quartz. If the forces arising from the polarisation produced by the vibration of a piezoelectric crystal are taken into account the discrepancy is removed. N. M. B.

Calculation of electrostatic potentials in the fluorite lattice. G. Bradistilov (*Z. Krist.*, 1939, 102, 26–46).—Vals. are calc. by a modification of Madelung's method, for the electrostatic potential at various lattice points in (111) layers near the boundary of a CaF_2 crystal. Data are also given for the potential due to the crystal at external positions which would be filled by further growth of the lattice. A. J. E. W.

Calculation of electrostatic potentials in the fluorite lattice. I. N. Stranski (*Z. Krist.*, 1939, 102, 47; cf. preceding abstract).—The bearing of Bradistilov's results on growth phenomena in CaF_2 crystals is briefly indicated. A. J. E. W.

Double refraction of barium cadmium chloride tetrahydrate. F. M. Quodling and D. P. Mellor (*Z. Krist.*, 1939, 102, 146;

cf. A., 1938, I, 180).—BaCdCl₄·4H₂O has α_D 1.610, β_D 1.646, γ_D 1.653 (all ± 0.003), double refraction 0.034 ± 0.006 .

A. J. E. W.

Determination of the elastic limit at twinning of calcite. R. I. Garber (*Physical Trans. Ukrain. Acad. Sci.*, 1940, 9, 59—66).—The elastic limit measured at a const. load was 100—940 g. per sq. mm., and at a const. deformation 120—1830 g. per sq. mm.; most of the vals. were between 150 and 350 g. per sq. mm. The apparatus and crystals used are described in detail.

J. J. B.

Mechanical twinning of calcite between -150° and 440°. R. I. Garber (*Physical Trans. Ukrain. Acad. Sci.*, 1940, 9, 67—70).—The elastic limit (see preceding abstract) was 220—330 g. per sq. mm. at 400° and 250—700 g. per sq. mm. at -150°. Below -120° CaCO₃ was brittle, and no permanent twinning took place.

J. J. B.

IV.—PHYSICAL PROPERTIES OF PURE SUBSTANCES.

Hysteresis cycle and its interpretation. L. F. Bates (*Proc. Physical Soc.*, 1941, 53, 468—479).—A lecture surveying the methods of obtaining and interpreting a hysteresis cycle, with special reference to the importance of the domain theory of magnetisation processes.

N. M. B.

Configuration of hydrogenated cupric disalicylaldehyde by means of magnetic measurements. G. N. Tyson, jun., and R. E. Vivian (*J. Amer. Chem. Soc.*, 1941, 63, 1403—1405).—Green Cu disalicylaldehyde is probably planar. The red reduced form, in which CHO groups have been changed to CH₂·OH groups, is probably tetrahedral and is relatively unstable; it reacts readily, loses H₂, and reverts to the green form.

W. R. A.

Magnetic studies of ferrohæmoglobin reaction. Equilibria and compounds with azide ion, ammonia, and ethyl alcohol.—See A., 1941, II, 275.

Dispersion of ultrasonic velocity in organic liquids. K. G. Krishnan (*Proc. Indian Acad. Sci.*, 1941, A, 13, 281—283).—The dispersion of ultrasonic velocity in 17 org. liquids has been investigated for 3 frequency ranges between 3500 and 8000 kc., using the diffraction method. For CH₂Cl·CO₂Et, COMe₂, and PrOH, an additional frequency of ~22,300 kc. was used. No dispersion could be observed, except in the case of AcOH, where an effect, if any, was very small.

A. J. M.

Heat capacity of halides of the iron group at low temperatures. I. G. Miljutin and N. Nachimovitch. II. G. Miljutin and E. A. Parfenova. III. G. Miljutin, E. A. Parfenova, and B. N. Eselson (*Physical Trans. Ukrain. Acad. Sci.*, 1940, 9, 71—74, 75—80, 81—84).—I. The mol. heat capacity C_m of FeBr₂, rising from 2.31 cal. per 1° at 12.12° K. to 15.9 at 110° K., passes through two max. at 14.1° (4.6 cal. per 1°) and 21.8° (3.18).

II. C_m of FeI₂ rises from 0.99 at 11.5° to 16.3 at 94°, remains const. up to 104°, and rises to 17.7 at 129° K. C_m of CoCl₂ rises from 0.305 at 11.8° to a max. (1.1 cal. per 1°) at 14.8°; a higher max. at 26° also exists. At both these temp. anomalies of the magnetic permeability occur.

III. C_m of CoI₂ is 3.35 at 16° K., 4.8 at 18.5°, 3.33 at 21.8°, and then regularly rises to 23.2 at 128.4° K. As the at. no. of the halogen increases the temp. of the Curie point and the relative height of the max. C_m are reduced.

J. J. B.

Heat capacity of organic vapours. I. Methyl alcohol. T. De Vries and B. T. Collins (*J. Amer. Chem. Soc.*, 1941, 63, 1343—1346).—Vals. of C_p for MeOH vapour have been determined from 75° to 170°, using a flow calorimeter in which the vapour was heated electrically. A flat min. in the C_p curve from approx. 110° to 150° is due to association of MeOH mols. in the vapour state.

W. R. A.

Triple point pressure of hydrogen. G. H. Messerly (*J. Amer. Chem. Soc.*, 1941, 63, 1486—1487).—Using the apparatus previously described (cf. A., 1940, I, 248) the triple point pressure of H₂ has been re-determined and is 53.85 ± 0.03 int. mm.

W. R. A.

Molal volume relationships among aliphatic hydrocarbons at their b.p. G. Egloff and R. C. Kuder (*J. Physical Chem.*, 1941, 45, 836—845).—Consts. in equations of the type $V = a(n + 4.4)^c + k$ (V = mol. vol. at b.p., n = no. of C atoms, a , c , and k are consts.) have been evaluated for 63 aliphatic

hydrocarbons to correlate V with n . Similarly, consts. in equations of the type $\log(V - k) = A\theta + B$ (θ = b.p., A and B are consts.) have been evaluated for 43 hydrocarbons to correlate V with θ . The average deviation between observed and calc. vals. is 0.48 and 0.79 ml. per mol. for the two types of equation respectively. In contrast to relations at 20°, V for a homologous series does not increase regularly with mol. wt.; e.g., V for n -alkanes, Δ^a -alkenes, and Δ^a -alkynes increases rapidly at first as n increases, but subsequently increases more slowly, attains a max., and decreases slowly as n is further increased.

C. R. H.

Thermal conductivity of liquids. M. R. Rao (*Physical Rev.*, 1941, [ii], 59, 212).—On assumptions previously reported (cf. A., 1941, I, 107), the expression calc. for the conductivity of a liquid near its f.p. is $K = 2.05 \times 10^5 (\theta_s / M V_s^{1/3})^2$, where θ_s is the m.p., and V_s the mol. vol.

N. M. B.

Joule-Thomson and Joule effects for Bose-Einstein and Fermi-Dirac gas. B. N. Singh (*Indian J. Physics*, 1940, 14, 459—473).—Mathematical. The Joule-Thomson effect and adiabatic process for a degenerate Bose-Einstein gas are discussed. A general formula for non-degenerate matter is given and the transition region from degeneracy to non-degeneracy in the Bose-Einstein gas is discussed. The Joule effect for various cases of matter obeying either statistics is worked out.

W. R. A.

Self-diffusion of silver. W. A. Johnson (*Amer. Inst. Min. Met. Eng.*, 1941, *Tech. Publ.* 1272, 5 pp.; *Met. Tech.*, 1941, 8, No. 1).—The self-diffusion coeff. of Ag at 725—950° was determined accurately from concn.-penetration curves obtained by the use of radioactive Ag. This consisted initially of about equal parts of ¹⁰⁸Ag and ¹⁰⁹Ag and was prepared from Pd by proton bombardment in a cyclotron. A layer was plated to a thickness of 0.0004 cm. on one side of a disc of Ag and covered by a similar disc which was welded to the active surface by heating to 750° under pressure. The composite specimens were annealed for several days in evacuated quartz tubes, after which thin layers were machined away parallel to the active surface. The material so removed was dissolved in HNO₃ and the radioactivity measured, using a Geiger-Müller counting circuit. The activation energy for the self-diffusion of Ag is 45,900 g.-cal. per mol., agreeing well with the val. given by the Dushman-Langmuir equation.

J. C. C.

V.—SOLUTIONS AND MIXTURES (INCLUDING COLLOIDS).

Compressibility of gas mixtures. II. p - v - T data for binary and ternary mixtures of methane, nitrogen, and hydrogen. I. R. Kritschewski and G. T. Levtschenko (*Acta Physicochim. U.R.S.S.*, 1941, 14, 271—278).—Compressibilities of 5 binary and 3 ternary mixtures of CH₄, N₂, and H₂ have been determined at 0°, 50°, 100°, 150°, and 200°, and at 100—700 atm. at intervals of 100 atm. The data are satisfactorily described by the equation of state proposed by Kritschewski and Kasarnovski (A., 1939, I, 605).

F. L. U.

Equation of state for gas mixtures. J. S. Kasarnovski (*Acta Physicochim. U.R.S.S.*, 1940, 13, 853—873).—The coeff. a in the equation previously derived (A., 1939, I, 605) for binary gas mixtures is shown mathematically to be a function of temp. if either component is a dipole; this deduction is confirmed by measurements on NH₃-H₂ and NH₃-N₂ mixtures. When the temp.-dependence of a is taken into account the equation reproduces satisfactorily the experimental data for these mixtures over a wide range of temp. and pressure, and can also be extended to liquid-gas systems, as shown by measurements on solutions of H₂ and N₂ in liquid NH₃. A similar equation for ternary mixtures agrees fairly with data for NH₃-H₂-N₂ mixtures.

F. L. U.

cycloHexanol as solvent for cryoscopic determination of mol. wts. H. N. Wilson and A. E. Heron (*J.S.C.I.*, 1941, 60, 168—171).—cycloHexanol (I) has a mol. depression of 377 and is shown to be a useful solvent for mol. wt. determinations. Macro- and micro-techniques are described. The liquidus curve for (I)-CCl₄ mixtures is traced.

B.p. elevation. IV. Potassium bromide in water. G. C. Johnson and R. P. Smith (*J. Amer. Chem. Soc.*, 1941, 63, 1351—1353).—The b.p. elevations for aq. KBr (0.1—5.0M.)

have been determined at 10° intervals between 60° and 100°. Partial mol. free energies have been deduced and the calculation of osmotic and activity coeffs. from the data is indicated. W. R. A.

Refractive indices and densities of aqueous-alcoholic electrolyte solutions. N. S. Filipova, I. S. Tartakovski, and M. E. Mansheley (*Acta Physicochim. U.R.S.S.*, 1941, 14, 257—270).—Apparatus and operational details of the measurements are described. Vals. of n_D for solutions of NH_4NO_3 and NaOAc in 68.9% aq. EtOH at 15°, 20°, and 25°, and of d^{20} for NaOAc are tabulated. F. L. U.

Specific heats of some aqueous solutions of sodium and potassium chlorides at several temperatures. III. Dilute sodium chloride solutions at 25°. C. B. Hess (*J. Physical Chem.*, 1941, 45, 755—761).—Greater precision in measurement is obtained with a new adiabatic twin calorimeter, the upper portions and covers of which are thermally insulated from the H_2O jacket. The sp. heats of dil. solutions (<0.15M.) of NaCl and of 0.148M- LiCl are recorded. C. R. H.

Vapour pressure of tantalum and niobium pentachloride, and of their mixtures with titanium tetrachloride. D. N. Tarasenkova and A. V. Komandin (*J. Gen. Chem. Russ.*, 1940, 10, 1319—1327).—V.p.-temp. curves are given for TaCl_5 and NbCl_5 . The solubility of TaCl_5 in TiCl_4 rises from 14.3% at 25° to 33.9% at 100°, and of NbCl_5 from 0.24 to 1.32%, over the same interval. The v.p. of the system $\text{TaCl}_5\text{--TiCl}_4$ at 140° \propto $[\text{TaCl}_5]$. R. T.

Relation between linear speed of crystallisation and viscosity for $\text{Na}_2\text{O--SiO}_2$ glasses. A. Leonteeva (*Acta Physicochim. U.R.S.S.*, 1941, 14, 245—256).—The linear crystallisation velocity (v) for 8 batches with SiO_2 content ranging from 50 to 80% was measured at a series of temp. Vals. of the consts. in the relation $v = k/\eta + k_0 \log \eta$ are tabulated. The second term is of minor importance in every case, and for glasses with 79.8, 74.0, and 65.1% of SiO_2 $k_0 = 0$, i.e., $v \propto$ fluidity. F. L. U.

Superlattices. C. Sykes (*J. Sci. Instr.*, 1941, 18, 152—153).—Additional, "superlattice," lines in an X-ray diagram are attributable to a state of order, e.g., in the alloy Cu_3Au . In CuZn and Ni_3Fe an enhanced difference in scattering power can be obtained by irradiation with radiation of λ very near to the absorption edge of one of the alloying constituents. A. A. E.

Precipitation in the solid state. G. D. Preston (*J. Sci. Instr.*, 1941, 18, 154—157).—Pptn. of a second phase from a supersaturated solid solution is considered. In the system Al--Cu small plates of Cu-rich material are first formed; at 200° formation of an intermediate phase of CuAl_2 with a CaF_2 structure follows, and at higher temp. tetragonal CuAl_2 results. Ag-Al alloys manifest a similar sequence. A. A. E.

Young's modulus of elasticity and its change with magnetisation in iron-cobalt alloys. M. Yamamoto (*Physical Rev.*, 1941, [ii], 59, 768).—Measurements obtained by the dynamic method of magnetostrictive oscillation are plotted for the relation between the max. of the change of Young's modulus, E , with magnetisation and the composition of the alloy. The val. is 0.234% for Armco Fe, increasing rapidly with Co content to a sharp max. of >22% at ~50% Co, followed by a decrease, but with two small max., before reaching the val. 0.168% for electrolytic Co. The curve for E at non-magnetised state plotted against composition shows that E for Fe increases with addition of Co up to ~30% Co, then decreases to a min. at ~85% Co, afterwards recovering to the val. for pure Co. Results are compared with those of Honda (cf. B., 1926, 545). N. M. B.

Rate of diffusion of nickel in γ -iron in low-carbon and high-carbon nickel steels. C. Wells and R. F. Mehl (*Amer. Inst. Min. Met. Eng.*, 1941, *Tech. Publ.* 1281, 10 pp.; *Met. Tech.*, 1941, 8, No. 1).—Diffusion rates of Ni in γ -Fe at 1050—1450° have been determined for 0—100% of Ni for steels containing 0.01—1.23% of C. The grain size and the presence of the impurities normally found in commercial steels do not affect the rate of diffusion. The results are given in curves and empirical equations. J. C. C.

Solubility of oxygen in high-purity copper. A. Phillips and E. N. Skinner (*Amer. Inst. Min. Met. Eng.*, 1941, *Tech. Publ.* 1280, 8 pp.; *Met. Tech.*, 1941, 8, No. 1).—Samples of Cu

were saturated with O_2 by first heating in air until a thin coating of oxide was formed and then heating in N_2 at a const. temp. until equilibrium was established. Excessive scaling was thus prevented. The surface oxide was then carefully removed and the $[\text{O}_2]$ determined by observing the loss of wt. on heating in H_2 . The solid solubility of O_2 in Cu varies from ~0.0018 at 550° to ~0.0045 at 1000° and is not affected by small differences in the nature and amounts of impurities in samples from various sources. These figures are appreciably < those found by Rhines and Mathewson (*Trans. Amer. Inst. Min. Eng.*, 1934, 111, 337). J. C. C.

Solubility studies. VI. Solubility of nitrobenzene in deuterium water and in ordinary water. H. E. Vermillion, B. Werbel, J. H. Saylor, and P. M. Gross (*J. Amer. Chem. Soc.*, 1941, 63, 1346—1347).—The solubility of PhNO_2 in D_2O at 6°, 30°, and 50°, measured by interferometric and analytical methods, is < in H_2O . W. R. A.

Solubility curves. N. V. Schischkin (*J. Gen. Chem. Russ.*, 1940, 10, 1213—1217).—Solubility diagrams are treated as composition-property curves of solutions. R. T.

Coprecipitation of barium ion with sulphides of the ammonium sulphide group in presence of ammonium ion. L. Lehman, J. Been, and I. Mandel (*J. Amer. Chem. Soc.*, 1941, 63, 1348—1350).—The loss of Ba^{++} ions in the pptn. of the sulphides of Ni, Co, Mn, Zn, and Fe from ammoniacal solution by H_2S in the presence of Ba^{++} ions has been studied. No SO_4^{--} ions are formed in sulphide pptn. With increasing $[\text{NH}_4^+]$ the loss decreases but is still appreciable in saturated aq. NH_4Cl . Post-pptn. causes a large loss for Ni, Co, and Mn, a smaller loss for Zn, and no loss with Fe. The loss is mainly attributed to surface adsorption on the pptd. sulphides, typical Freundlich isotherms being observed. Loss by occlusion is small. W. R. A.

Ageing and coprecipitation. XXXIV. Ageing of freshly precipitated lead chromate. I. M. Kolthoff and F. T. Eggertsen (*J. Amer. Chem. Soc.*, 1941, 63, 1412—1418; cf. A., 1940, I, 409).—The average particle size of PbCrO_4 , freshly pptd. from $\text{Pb}(\text{NO}_3)_2$ and K_2CrO_4 , has been investigated under varying conditions and the ageing of the ppt. studied by (i) following the rate of penetration of Th-B into the ppt. and (ii) measuring the rate of decrease of the sp. surface by the wool-violet adsorption method in various solvents. The average particle size decreases markedly with vigorous stirring and, contrary to the von Weimarn rule, decreases with decreasing concn. of the precipitants. The sp. surface is independent of the method of pptn. Th-B rapidly penetrates a fresh imperfect ppt., giving a pronounced max. $[\text{Pb}^*]$ which is \gg the equilibrium distribution val. gradually approached by continued shaking. The behaviour is attributed to rapid recrystallisations in the ppt. The rates of recrystallisation and ageing are approx. the same in H_2O , 0.01M- $\text{Pb}(\text{NO}_3)_2$, and 0.01M- K_2CrO_4 . The rate of ageing is considered to be determined by the rate of exchange of lattice ions between the ppt. and the H_2O film surrounding the individual particles resulting in rapid growth in particle size, which is independent of excess lattice ions in solution. No Ostwald ripening occurs in aq. media. The rate of ageing is greatly enhanced by the presence of acids which increase solubility. No ageing occurs in 95% EtOH, in which the solubility of the ppt. is small. W. R. A.

Adsorption of alaphazurine by potassium nitrate. N. Whitman and C. Rosenblum (*J. Physical Chem.*, 1941, 45, 801—806).—Crystals of KNO_3 suspended in COME_2 solutions of alaphazurine A adsorb $\sim 4.2 \times 10^{-7}$ g. of dye per sq. cm. of crystal surface, corresponding with each dye mol. covering an average of three KNO_3 mols. C. R. H.

Adsorption of mixed acids from their solutions in single and mixed solvents. II. N. Jermolenko and M. Bochvala (*Acta Physicochim. U.R.S.S.*, 1940, 13, 839—852; cf. A., 1941, I, 10).—Data are recorded for the adsorption on active C of BzOH , $\text{o-OH}\cdot\text{C}_6\text{H}_4\cdot\text{CO}_2\text{H}$, and $\text{Bu}^+\text{CO}_2\text{H}$, singly and in pairs, from solutions in $\text{C}_6\text{H}_6 + \text{CCl}_4$, $\text{C}_6\text{H}_6 + \text{CHCl}_3$, $\text{C}_6\text{H}_6 + \text{EtOH}$, $\text{EtOH} + \text{CHCl}_3$, and $\text{EtOH} + \text{H}_2\text{O}$, and in the pure solvents. The shape of the adsorption isotherm for each of the acids is not significantly changed by the presence of a second acid. There is a general reciprocal relation between adsorption and solubility in the mixed as well as in the pure solvents. Provided one or both of the components of a solvent mixture are

non-polar, the Freundlich-Masius rule (cf. A., 1911, ii, 374) is valid for mixed solvents. F. L. U.

Comparative study of surfaces of solutions with the film balance and surface tension equipment. J. W. McBain and E. R. Sharp (*J. Amer. Chem. Soc.*, 1941, **63**, 1422–1426).—The changing pressures (cf., A., 1940, I, 209) observed on compressing and expanding superficial areas of solutions of hydrocinnamic acid (I) and the Na_2 sulphonate of dioctyl succinate (II) have been investigated by the film balance method and compared with changes in γ on the same surfaces measured by a tensiometer. Both changes are similar in kind. (I) requires 1000–2000 min. to attain const. vals. of γ . When the surfaces of (I) and (II) are suitably reduced in area a pellicle is formed which is insol. below a definite pressure. For (II) the pressure is a max. at 75% compression. Measurements with KCl and Na silicate have been made. For 0.001N-KCl a temporary surface pressure apparently results from surface compression. W. R. A.

Monolayers of compounds with branched hydrocarbon chains. IV. Phthioic acid. E. Stenhagen and S. Stållberg (*J. Biol. Chem.*, 1941, **139**, 345–364).—When spread on 0.01N-HCl from petrol solution, phthioic acid (I) forms liquid-condensed films of limiting area 52 sq. A. at 5° and 62–63 sq. A. at 20°. They cannot be compressed beyond 36.5 sq. A. without collapse. The apparent surface moment of the acid is 0.35–0.38 D., a very high val. for a saturated fatty acid. Films spread on a phosphate buffer (p_H 7.2) and 0.01N-NaOH have also been investigated. From a substrate of 3×10^{-4} M-BaCl₂ multilayers of Ba phthioate have been obtained on Cr-plated brass slides. Optical measurements indicate a spacing of 18.2 ± 0.5 A. per layer, whilst X-ray examination indicates a long spacing of 35 ± 0.7 A., corresponding with a vertical or slightly tilted double mol. arrangement. It is suggested that (I) may be a trisubstituted AcOH, with two long chains and one short one. This is in accord with all its known properties. J. W. S.

Mechanical properties of monolayers obtained by two-dimensional polymerisation and condensation. S. E. Bresler, M. Judin, and D. Talmud (*Acta Physicochim. U.R.S.S.*, 1941, **14**, 71–84).—Arrangements for studying the mechanical properties (viscosity and rigidity) of monolayers are described. By the use of polyfunctional mols., surface condensation and polymerisation reactions have been realised, which give rise to the two-dimensional analogues of a viscous liquid, a rubber-like solid, and a brittle solid. F. J. G.

Expanded state and binary films. S. E. Bresler and P. F. Pochil (*Acta Physicochim. U.R.S.S.*, 1941, **14**, 85–104).—The properties of binary films, consisting of a surface-active substance and a long-chain hydrocarbon, have been studied. Solid hydrocarbons are completely extruded from the film, but liquid hydrocarbons give a homogeneous film with >5 mols. of hydrocarbon per mol. of active substance. In presence of the hydrocarbon ("two-dimensional solvent") the discontinuous expansion point disappears, and on compression the val. for the limiting area per mol. is $<$ for the ordinary film, and is equal to that in the crystal. The interpretation of these results, and also the thermodynamics of the expansion, considered as a phase change of the second kind, are discussed. F. J. G.

Oiliness of liquids. X. Friction coefficients of uni- and multi-molecular layers. T. Isemura (*Bull. Chem. Soc. Japan*, 1940, **15**, 467–474).—The coeffs. of friction (μ) between glass plates covered with uni- and multi-mol. layers of long-chain acids, alcohols, and esters have been studied. With acids, μ for a unimol. layer is ~ 0.1 of the val. for clean glass, and with increasing no. of mol. layers ($> \sim 7$), μ decreases further, except with oleic acid. With alcohols and esters μ is somewhat $>$ with acids, and fluctuates rather widely. Increasing compression of the film causes a decrease of μ , and films deposited from alkaline media give $\mu <$ those from acid media. Stearic acid films on tap- H_2O are more easily transferred to glass than those on distilled H_2O , and have limiting area 20.6 sq. A. as against 24.6 sq. A. on distilled H_2O . This is due to the presence of traces of Ca, for after addition of $(\text{NH}_4)_2\text{C}_2\text{O}_4$ the same val. as for distilled H_2O is obtained. F. J. G.

Friction and adhesion. J. J. Bikerman (*Phil. Mag.*, 1941, [vii], **32**, 67–76).—A review of recent literature, from which it is concluded that friction cannot be due to welding or

adhesion, since frictional properties are not related to fusibility and residual normal forces cannot be detected. Experiments with decreasing loads do not support the hypothesis of adhesion at real areas of contact \propto the load. Frictional effects may be simulated by the effect of scratch-hardness. The welding theory is not supported by "stick-and-slip" patterns. It is concluded that the abs. vals. of the coeff. of friction are accounted for by Coulomb's theory attributing friction to surface asperities. L. J. J.

Action of alkaline-earth chlorides on emulsions stabilised by sodium oleate. A. H. Adams and A. R. Martin (*J.C.S.*, 1941, 352).—After "standard" C_8H_7 emulsions have been broken by treatment with quantities of CaCl_2 , SrCl_2 , or BaCl_2 equiv. to the Na oleate present, the C_8H_7 phase contains most of the alkaline-earth metal soap, in which the ratio acid : metal is $>$ in the normal oleate. The excess follows the same order as the coagulating powers of the salts ($\text{Ba} > \text{Sr} > \text{Ca}$), thus supporting the conclusions of Martin and Hermann (A., 1941, I, 81). J. W. S.

Molecular size distributions and depolymerisation reactions in polydisperse systems. E. Montroll (*J. Amer. Chem. Soc.*, 1941, **63**, 1215–1220).—A polydisperse system of long-chain mols. of the same general structure with a single mol. size distribution is treated statistically. A general distribution function which shows deviations from normal is developed. A theory of depolymerisation, which assumes that all bonds connecting monomeric elements in the system have the same probability of being broken, is given. The mol. size distribution at any instant is given as a function of the initial distribution and the fraction of the bonds broken. Assuming that the rate at which bonds are broken \propto the no. of unbroken bonds in the system, the time-dependence of the degree of depolymerisation is discussed. W. R. A.

Elastic and thermo-elastic properties of rubber-like materials.—See B., 1941, II, 282.

Analogy between the mechanism of deformation of cellulose and that of rubber. P. H. Hermans (*J. Physical Chem.*, 1941, **45**, 827–836).—The literature of cellulose and rubber dealing with the similarity in the behaviour of regenerated cellulose and rubber during deformation is reviewed and possibly fruitful lines of research are indicated. C. R. H.

Electrochemistry of agar sol. W. Pauli and L. Sternbach (*Helv. Chim. Acta*, 1941, **24**, 317–339; cf. A., 1937, I, 360).—Conductivity measurements indicate that on dilution the activity coeff. of the acidic form of agar (I) reaches a const. val. of ~ 0.66 . This is attributed to the fact that there are two HSO_4 groups to one glycuronic acid group, the ionisation of the latter being almost completely suppressed in (I). There are ~ 3.6 monose residues per acid group. Conductivity measurements on Na agarate (II) indicate a splitting of mol. aggregates at a crit. concn. of $\sim 5 \times 10^{-4}$ N. The behaviour is closely similar to that of paraffin-chain salts. The η of (II) sol prepared at room temp. is slightly $>$ that of the (I) sol of equal concn., but when prepared by warming the η of (II) is $<$ that of (I), approaching its val. at low concn. Addition of NaCl to the sols which have not been heated causes a decrease in η , but a max. effect is obtained when the (I) and (II) sols are 2×10^{-2} and 2×10^{-3} N., respectively, in NaCl, after which the η is equal for the two sols and is unchanged by further addition of NaCl. Sols which have been heated, however, show a definite min. of η after which further addition of NaCl causes an increase in η . The results are discussed with reference to the electrostatic viscosity effect and the influence of mean particle size. The biochemical aspects of the problem are also discussed. J. W. S.

p_H at surface of ovalbumin molecules, and protein error with indicators.—See A., 1941, III, 621.

Streaming optical and viscometric investigations of the state of solution of casein. I. H. Nitschmann and H. Guggisberg (*Helv. Chim. Acta*, 1941, **24**, 434–458; cf. A., 1938, I, 249).—The influence of various concns. of KCl, KBr, KI, and Na_2SO_4 on the streaming double refraction (Δn) and η of 4% aq. Na caseinate solutions has been investigated. The decrease in Δn and η produced by low salt concns. is due to the electro-viscosity effect, whilst the increase in Δn in presence of high concns. of Na_2SO_4 , NaCl, and KCl, and the decrease in Δn in presence of high concns. of KBr and KI, are attributed to changes in the degree of dispersion. There is a third effect, causing a wave near the min. of the Δn curve, probably related

to a swelling min. of the dispersed casein particles. The particles are supposed to be of needle form, and aggregation to comprise arrangement of these in parallel but staggered clusters, so that, whilst of needle form, the axial ratio is $<$ in the individual mols. Addition of KCl or Na_2SO_4 also increases the rate of increase in the angle of orientation of the double refraction with increasing streaming gradient. J. W. S.

Moving boundary electrophoretic study of insulin. J. L. Hall (*J. Biol. Chem.*, 1941, 139, 175—184).—Electrophoretic measurements on cryst. insulin by the moving boundary method indicate that it behaves as a homogeneous protein. Various insulin preps., including one of activity 16 units, are shown to have properties indistinguishable by this method from those of cryst. insulin. The presence of Zn^{++} in acid buffer solutions has no effect on the boundary concn. gradient and mobility of insulin. J. W. S.

Electrokinetics. XXIV. Electro-viscous effect. I. Systems of sodium gum arabic. D. R. Briggs (*J. Physical Chem.*, 1941, 45, 866—876).—A rearrangement of the Smoluchowski equation for the electro-viscous effect permits a testing of the equation against data for the electrokinetic potential (ζ), sp. conductivity (λ), and relative η ($= \eta/\eta_0$) of colloid-containing solutions. Linear plots of the reciprocal of sp. η against $\zeta^2/\lambda(\eta_0 - \eta_0)$ obtained for various concns. of Na gum arabic with or without addition of NaCl confirm the validity of the new equation, although the apparent decrease in colloid particle radius with increase in colloid concn. suggests that some small additional factor should be taken into account when deriving the equation. C. R. H.

Effects of electrolytes in hydrophobic systems. I. Electric mobility and stability. II. Sol concentration and electrolyte stability. III. Mixtures of electrolytes. Ion antagonism. F. Hazel (*J. Physical Chem.*, 1941, 45, 731—738, 738—746, 747—755).—I. The mobilities of MnO_2 and As_2S_3 sols at the flocculating concn. of several electrolytes have been measured. Univalent ions coagulate the sols at higher crit. mobilities than multivalent ions. Coagulation by univalent ions depends on compression of the diffuse layer at high concns., whilst with multivalent ions the controlling factor in coagulation is a reduction in the particle charge by adsorption.

II. With the exception of KCl with As_2S_3 , dilution of sols lowers the crit. mobility towards electrolytes, suggesting that the repulsive forces between the sol particles must be reduced to a lower val. during coagulation in order to compensate for the decreased chance of collision of the particles as a result of dilution. Two opposing factors, increased ion adsorption and lower crit. mobilities accompanying dilution, determine the effect of dilution on the coagulating power of ions. Thus, increased adsorption of multivalent ions with sol dilution tends to decrease the repulsive forces through reduction of the electric charge, thereby increasing the pptg. power of multivalent ions. On the other hand, the coagulating effect of these ions is opposed by dilution since more adsorption is necessary to allow for a lower crit. potential.

III. Mixed electrolytes show no evidence of ionic antagonism except KCl and BaCl_2 with As_2S_3 sols. The data are discussed in the light of ideas developed in Parts I and II. C. R. H.

Coagulation of colloids by bi-metallic junctions. P. B. Ganguly (*Current Sci.*, 1941, 10, 75).—The coagulation of As_2S_3 sol by an Fe-Al couple has been investigated. Rapid coagulation occurs at points on the couple where H_2 is most vigorously evolved. The flocculation of the sol is mainly attributed to electrolyte coagulation. The process provides a better method of studying the Schultz-Hardy law for coagulation by metallic ions than those in which the disturbing influence of a conjugate ion is present. W. R. A.

VI.—KINETIC THEORY. THERMODYNAMICS.

Rate and equilibrium studies on the thermal reaction of hydrogen and iodine. A. H. Taylor, jun., and R. H. Crist (*J. Amer. Chem. Soc.*, 1941, 63, 1577—1585).—Equilibrium consts. (K) for the dissociation of HI and DI have been determined in the range 666–8° to 763–8° K. and are compared with existing data. The ratio of the rate consts. for H_2 and D_2 in combination and decomp. reactions have been determined at 666–8° and 698–6° K. and are compared with existing data. W. R. A.

Electrolytic dissociation processes. III. Exchange of radio-bromine between inorganic and organic bromides. F. Fairbrother (*J.C.S.*, 1941, 293—299; cf. A., 1937, I, 320).—Exchange of radioactive Br between AlBr_3 and most org. Br compounds is complete in a few min. at room temp., but with PhBr the exchange is slow. SnBr_4 , SbBr_3 , AuBr_3 , and other inorg. bromides exchange Br slowly, excepting with the more easily ionisable org. bromides (Bu^nBr). The ease of exchange is correlated with the energy of formation of a metal complex ion and the ionisation potential of the org. radical. J. W. S.

Properties of ions. IV. Ionic radii and exchange reactions of alkali halides. B. N. Nekrassov and D. A. Botschvar (*J. Gen. Chem. Russ.*, 1940, 10, 1218—1219).—In reactions of the type $\text{AX} + \text{BY} \rightleftharpoons \text{AY} + \text{BX}$, in absence of a solvent (A and B are alkali metals, X and Y are halogens), the equilibrium mixture is such as contains the greatest relative amount of the salts AY and BX, where the ionic radius of $\text{A} > \text{B}$, and of $\text{X} < \text{Y}$. R. T.

Alcohol error of indicators. Behaviour of acid-base indicators in the system water-alcohol-ammonium sulphate. A. G. Kobljanski (*J. Gen. Chem. Russ.*, 1940, 10, 1247—1256).—The colorations of the upper and lower layers of the systems conc. aq. NH_4Cl -EtOH-indicator, within the transition zone of the indicator, differ. This is due to the greater solubility of the non-ionised form of the indicator in the solvent of lower polarity. R. T.

Activity of glycine in aqueous solutions of potassium chloride, from electromotive force measurements. R. M. Roberts and J. G. Kirkwood (*J. Amer. Chem. Soc.*, 1941, 63, 1373—1377).—Vals. of the activity coeff. (γ) of glycine in aq. KCl have been calc. from measurements at 25° of the e.m.f. of the cell $\text{Ag}|\text{AgCl}|\text{KCl}(m_1)|\text{KCl}(m_2)|\text{glycine}(m_2)|\text{AgCl}|\text{Ag}$, m_1 and m_2 being varied from 0.05 to 0.50M. The dipole moment of the glycine dipolar ion is calc. as 14.4 D. W. R. A.

Isomerisation of hydrocarbons. V. Pentanes. B. Moldavski and T. Nizovkina (*J. Gen. Chem. Russ.*, 1940, 10, 1183—1188).—The equilibrium coeff. of the reaction $n\text{-C}_5\text{H}_{12} \rightleftharpoons \text{iso-C}_5\text{H}_{12}$ at 25—90°, in presence of AlCl_3 and CuSO_4 , is given by $\log k = 511/\theta - 0.820$. R. T.

Equilibria in phenol-water systems. G. Antonoff, M. Hecht, and M. Chanin (*J. Physical Chem.*, 1941, 45, 791—793).—Although the interfacial tension (γ_{12}) between PhOH and H_2O is const., the val. of γ_{12} ($= \gamma_1 - \gamma_2$) calc. from vals. of γ_1 and γ_2 for the two liquids against air has a large negative val. at first which rapidly decreases and then slowly approaches the observed val., which is reached after several days. $\gamma_1 - \gamma_2$ then remains const. At higher temp. the initial val. of $\gamma_1 - \gamma_2$ is positive and $>$ the observed val. and attains the latter much more rapidly. Similar irregularities are observed when the densities of the two layers are plotted as a function of time, suggesting that the variations are not due solely to surface phenomena but depend on some mol. rearrangement. C. R. H.

Binary system sodium formate-acetic acid. Solutions of sodium acetate in formic acid. A. W. Davidson and E. A. Ramskill (*J. Amer. Chem. Soc.*, 1941, 63, 1221—1224).—Transition point and solubility data for the solvates of HCO_2Na in AcOH are given and the compounds $\text{HCO}_2\text{Na} \cdot 2\text{AcOH}$ and $\text{HCO}_2\text{Na} \cdot \text{AcOH}$ have been isolated. HCO_2Na and NaOAc in AcOH behave similarly. In HCO_2H NaOAc is extensively solvolyzed. W. R. A.

System sodium dichromate-water. W. H. Hartford (*J. Amer. Chem. Soc.*, 1941, 63, 1473—1474).—The system $\text{Na}_2\text{Cr}_2\text{O}_7 \cdot \text{H}_2\text{O}$ has been investigated by solubility methods through the range 0—80 wt.-% of $\text{Na}_2\text{Cr}_2\text{O}_7$. It exhibits a eutectic point at -48.2° (60.77 wt.-% of $\text{Na}_2\text{Cr}_2\text{O}_7$). The transition $\text{Na}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O} \rightarrow \text{Na}_2\text{Cr}_2\text{O}_7$ occurs at 84.6° (79.18 wt.-% of $\text{Na}_2\text{Cr}_2\text{O}_7$). W. R. A.

Apparent solubility product of chromous hydroxide. Significance of the solubility products of the hydroxides of the metals which form basic salts. D. N. Hume and H. W. Stone (*J. Amer. Chem. Soc.*, 1941, 63, 1197—1199).—Application of the solubility product principle to the hydroxide of a bivalent metal, $\text{M}(\text{OH})_2$, assumes that the $\text{M}(\text{OH})_2$ is in equilibrium with its ions in solution and excludes the possibility of formation of a basic salt of quite distinct properties. Addition of dil. alkali to CrCl_2 gives a basic salt, the composition and

colour of which vary with the concn. of reactants and the rate of mixing. From the p_H of the solution the apparent solubility product has been calc. as 1.0×10^{-17} . Measurements on a basic salt yielded lower vals. A three-phase mixture of $\text{Cr}(\text{OH})_3$, basic salt, and solution is formed and the solubility product principle cannot, therefore, be applied to $\text{Cr}(\text{OH})_3$, nor, generally, to hydroxides of bivalent metals.

W. R. A.

Solubility curve of sodium deoxycholate in water. R. D. Vold and J. W. McBain (*J. Amer. Chem. Soc.*, 1941, 63, 1296—1298).—The temp. of formation of isotropic liquid in the system Na deoxycholate (I)— H_2O have been determined for 0 to 100% of (I). The solubility curve shows that an octahydrate of (I) exists in a certain concn. range at $\sim 74\%$ of (I), which, however, is completely dissociated in the dissolved state. No liquid cryst. phase has been observed and the system closely resembles a soap solution in colloidal properties and ability to solubilise H_2O -insol. substances. The structural requirements for the existence of liquid cryst. forms are briefly discussed.

W. R. A.

Phase behaviour of dodecanesulphonic acid and of its alkali salts with water. M. J. Vold (*J. Amer. Chem. Soc.*, 1941, 63, 1427—1432).—The phase behaviour of the system dodecanesulphonic acid (I)— H_2O has been investigated dilatometrically. Cryst. solid, isotropic solution, a cryst. monohydrate, and two liquid cryst. solutions have been observed. (I) does not exhibit formation of liquid crystals but interaction with H_2O leads to their formation. Li, Na, and K salts of (I) have a transition from crystal to liquid resembling subneat soap. In general the behaviour of (I) and its alkali salts is similar to that of the soaps.

W. R. A.

Phase-rule study of the system sodium myristate-water. R. D. Vold, R. Reivere, and J. W. McBain (*J. Amer. Chem. Soc.*, 1941, 63, 1293—1296).—The transition temp. of the 12 phases existing in the system Na myristate— H_2O have been determined by the hot wire, the dilatometric and microscopic methods, and by viewing experiments at selected temp. The phase diagram has been constructed. The phase behaviour is qualitatively similar to other saturated soap— H_2O systems, in particular to Na oleate— H_2O . In contrast to Na palmitate— H_2O the change from sub-waxy to waxy and from waxy to super-waxy soap was detected microscopically. The effect of the chain length of the soap mols. on the phase diagram is considered to involve at least two opposing factors; thus (i) the longer-chain soaps are less sol. at low temp. and low soap concn. whilst (ii) the shorter-chain soaps are less sol. at high temp. and high soap concn.

W. R. A.

Solubility in the system $\text{Na}_2\text{SO}_4 + 2\text{HCl} \rightleftharpoons \text{H}_2\text{SO}_4 + 2\text{NaCl}$, at 25°. D. M. Korf and L. P. Schatrovskaja (*J. Gen. Chem. Russ.*, 1940, 10, 1231—1235).—The phase diagram of the quaternary system is given.

R. T.

Basic chlorides. A. Zacharov (*J. Gen. Chem. Russ.*, 1940, 10, 1230).—Polemical against Fridman (A., 1940, I, 74).

R. T.

Application of X-ray methods to determination of phase boundaries.—See B., 1941, I, 369.

Polyiodides of caesium. III. F.p., solubility, and b.p. relationships in the system caesium iodide-iodine-water at approximately standard pressure. T. R. Briggs and S. S. Hubbard (*J. Physical Chem.*, 1941, 45, 806—827).—The results of a comprehensive polythermal phase rule study of the systems $\text{CsI}-\text{H}_2\text{O}$ and $\text{CsI}-\text{I}_2-\text{H}_2\text{O}$ are tabularly and diagrammatically presented. The ternary system contains two binary compounds, CsI and CsI_2 , and a binodal region. The major part of the b.p. liquidus diagram for the ternary system is also reproduced.

C. R. H.

System $\text{H}_2\text{O}-\text{HCl}-\text{SO}_3$. I. Thermal and ebulliometric study of the system $\text{H}_2\text{SO}_4-\text{H}_2\text{S}_2\text{O}_7-\text{ClSO}_3\text{H}$. G. P. Lutschinski (*J. Gen. Chem. Russ.*, 1940, 10, 1266—1279).— H_2SO_4 and ClSO_3H are miscible in all proportions; they do not combine with each other. A 1:1 compound, m.p. 2.6°, and a 1:2 compound, m.p. 3.1°, are formed in the system $\text{H}_2\text{S}_2\text{O}_7-\text{ClSO}_3\text{H}$. The phase diagram of the ternary system $\text{H}_2\text{SO}_4-\text{H}_2\text{S}_2\text{O}_7-\text{ClSO}_3\text{H}$ consists of five fields of crystallisation, with three triple eutectic points. The b.p.-composition curves of this system are a series of non-intersecting curves concave to the $\text{H}_2\text{S}_2\text{O}_7$ corner, and convex to the H_2SO_4 corner.

R. T.

Thermodynamic calculations for the ternary system o -, m -, and p -xylene. V. M. Kravtschenko (*Acta Physicochim.*

U.R.S.S., 1941, 14, 279—286).—Solid-liquid equilibria have been calc. on the basis of published data for the binary systems, and the results are shown in a diagram. Comparison of calc. with observed vals. for the binary systems shows that the latter approximate closely to ideal solutions. The calc. ternary eutectic is at -63.7° and 28.7, 62.8, and 8.5 mol.-% of o -, m -, and p -xylene.

F. L. U.

Potential energy in thermodynamics. V. Njegovan (*Acta Physicochim. U.R.S.S.*, 829—838).—The use of the mean potential energy in the derivation of thermodynamic formulae is discussed (cf. A., 1941, I, 35).

F. L. U.

VII.—ELECTROCHEMISTRY.

Specific gravities and electrical conductances of some calcium sulphate solutions and mixtures of sodium chloride and calcium sulphate. R. E. Hamm and T. G. Thompson (*J. Amer. Chem. Soc.*, 1941, 63, 1418—1422; cf. A., 1939, I, 373).—Vals. of A , sp. gr., and temp. coeff. of A for aq. CaSO_4 (I) and for aq. mixtures (II) of CaSO_4 and NaCl of const. ionic ratio have been determined at 0°, 5°, 10°, 15°, 20°, and 25° over the concn. range 4 mg. to 22 mg. per l. Vals. of sp. gr. for (I) and (II) agree with the Root equation and the required consts. have been computed by the method of least squares. An expression for the sp. conductance of (II) is derived; calc. and observed vals. agree within 0.01% over the concn. range investigated.

W. R. A.

Electrical double layer at a mercury surface. I. Methods of measurement and interpretation of results. D. C. Grahame (*J. Amer. Chem. Soc.*, 1941, 63, 1207—1215).—The static (Q_s) and differential (Q_d) capacities of an electrical double layer are defined and related mathematically. Vals. of (Q_s) for Hg in N-NaNO_3 , $\text{-Na}_2\text{SO}_4$, -NaCl , $\text{-Na}_2\text{CO}_3$, and -NaI and 0.1N- Na_2SO_4 and of (Q_d) for Hg in N-NaNO_3 , -KNO_3 , $\text{-H}_2\text{SO}_4$, $\text{-Na}_2\text{SO}_4$, -NaCl , $\text{-Na}_2\text{CO}_3$, and -NaI and in 0.1N- KClO_4 , -NaNO_3 , $\text{-Na}_2\text{SO}_4$, -NaCl , and -NaI have been determined using a dropping Hg electrode. At high positive potentials large increases in (Q_s) and (Q_d) were observed and are attributed to (i) incipient pptn. of anions held by forces of a chemical nature to the Hg surface and (ii) reversible electro-reduction of ions at the Hg surface at potentials $>$ for (i), giving rise to very high capacities ("pseudo" capacity).

W. R. A.

Anodic waves involving electro-oxidation of mercury at the dropping mercury electrode. I. M. Kolthoff and C. S. Miller (*J. Amer. Chem. Soc.*, 1941, 63, 1405—1411).—The electro-oxidation of Hg at the dropping Hg electrode alone and in the presence of (i) the depolarisers $\text{S}_2\text{O}_3^{2-}$, SO_3^{2-} , OH^- , CNS^- , and CN^- , and (ii) Cl^- , Br^- , I^- , and S^{2-} , has been investigated in 0.1N- KNO_3 at 25°. The anodic waves of $\text{S}_2\text{O}_3^{2-}$ and SO_3^{2-} correspond with the formation of a complex ion, e.g., $\text{S}_2\text{O}_3^{2-} + \text{Hg} \rightleftharpoons \text{Hg}(\text{S}_2\text{O}_3)_2^{2-} + 2e$. The anodic waves of OH^- and CNS^- correspond with the formation of $\text{Hg}(\text{OH})_2$ and $\text{Hg}(\text{CNS})_2$ respectively. The half-wave potentials of $\text{S}_2\text{O}_3^{2-}$, SO_3^{2-} , OH^- , and CNS^- are -0.145 , -0.007 , $+0.08$ and $+0.18$ v., respectively. The anodic waves of Cl^- , Br^- , and I^- correspond with the formation of Hg_2^{2+} salts. At certain current vals. the Hg_2^{2+} salts form a film on the drop. For Br^- the drop becomes polarised at a certain thickness of film causing a second anodic wave to appear which is eliminated by traces of gelatin. The film of Hg_2I_2 causes irregularity in growth of the drop and induces pulsating effects. The effect of the film formation on the electrocapillary behaviour of Hg has been determined. All ions considered can be determined polarographically.

W. R. A.

Kinetics of processes on the platinum electrode. I. Kinetics of the ionisation of hydrogen adsorbed on a platinum electrode. P. Dolin and B. Erschler. **H. Rate of discharge of H ions and rate of the over-all process of hydrogen evolution on platinum.** P. Dolin, B. Erschler, and A. Frumkin. **III. Influence of diffusion of molecular hydrogen on the capacity of the platinum electrode.** A. Frumkin, P. Dolin, and B. Erschler (*Acta Physicochim. U.R.S.S.*, 1940, 13, 747—778, 779—792, 793—802).—I. The kinetics of discharge and ionisation at a smooth Pt cathode in various electrolyte solutions was studied by measuring the capacity and ohmic components of the electrode conductivity with a.c. over the frequency range 10—6750 cycles per sec. At sufficiently high frequency the ohmic component, divided by (F/RT) , is equal to the abs. rate of discharge and ionisation, processes

which are thus shown to occur with finite velocity. The rate is independent of potential in the region where the electrode surface is covered to a medium degree, a fact accounted for by assuming that the surface is heterogeneous. The rate of discharge and ionisation increases in the order $\text{NaOH} < \text{H}_2\text{SO}_4 < \text{HCl} < \text{HBr}$, which is explained by the influence of sp. adsorption of the ions. The oxidation of Pt is very slow in acid and considerably faster in alkaline solutions.

II. By measuring the overvoltage (η) of H on Pt in various electrolytes over a range of concn. the rate of the discharge stage is found to be in HCl 27 times and in NaOH 11 times that of the over-all process $2\text{H}^+ \rightleftharpoons \text{H}_2$, at the reversible H potential. It is inferred that η on Pt is determined (a) by the rate of discharge of H ions on free and covered regions of the electrode with formation of adsorbed atoms and of H_2 , respectively, and (b) by the rate of the inverse reactions. An equation relating η to the c.d. for a heterogeneous surface and for small vals. of η is derived.

III. Krüger's equation (cf. A., 1903, ii, 707) for the polarisation capacity of a Hg electrode is not directly applicable to Pt, since it assumed the instantaneous establishment of equilibrium between H^+ in the solution and H adsorbed on the surface. Expressions for the variation of the capacity and of the ohmic component of the conductivity of a Pt electrode with frequency are derived, allowing for the finite rate of evolution of H_2 . F. L. U.

VIII.—REACTIONS.

Reaction of free methyl radicals with nitric oxide. J. S. A. Forsyth (*Trans. Faraday Soc.*, 1941, 37, 312–318).—The rate of decay of Me radicals, prepared by pyrolysis of Et_2O at 0.6 mm. pressure, was determined by observing the rate of removal of a Te mirror. The calc. val. of the half-life period is 7.5×10^{-3} sec. One radical disappears for every 5×10^5 collisions at the wall of the container, and for every 360 collisions with the Te mirror. In presence of NO the rate of disappearance is greatly increased, one Me being destroyed for every 73,000 collisions with NO mols. The activation energy of this process is ~ 6.5 kg.-cal. No HCN could be detected in the reaction products. F. L. U.

Temperature and latent energy in flame gases. W. T. David (*Engineer*, 1941, 171, 268–271; cf. A., 1941, I, 117).—The temp. recorded by a fine Pt-Rh wire placed near the centre of a spherical explosion vessel filled with CO-air mixture is $<$ the calc. flame temp. and after allowing for loss by radiation from the hot gases and the wire there remains in the gases a "latent energy" which is ascribed to abnormal CO_2 mols. readily dissociated owing to this excess of internal energy, which is discharged at catalytic surfaces such as that of the Pt-Rh wire. Hence a quartz-covered wire records still lower temp. except with rich mixtures ($> 50\%$ CO) in which dissociation is suppressed, and these are held to represent the true mean translational energy. The latent energy is relatively smaller in a larger vessel and is therefore thought to be developed during the early stages of the explosion when the flame is propagated by chain diffusion rather than thermal conduction (cf. A., 1937, I, 246). A. R. PE.

Halogenation of phenolic ethers and anilides.—See A., 1941, II, 221.

Survey of certain factors affecting the autoxidation of sodium stannite. R. W. Peterson and J. H. Walton (*J. Physical Chem.*, 1941, 45, 794–801).—The autoxidation of alkaline solutions of Na_2SnO_3 is a first-order reaction, the rate increasing slightly with decrease in p_{H} . Many org. N compounds inhibit the reaction and inorg. NH_4 salts are especially effective. Ethers, ketones, chloro-compounds, and S have no influence, nor has illumination. Powdered Pyrex glass accelerates the reaction. The data are consistent with the formation of an intermediate unstable perstannate. A general feature of the most effective inhibitory compounds is the presence of a N atom with unshared electrons which inhibits oxidation through its own tendency to combine with O. C. R. H.

Rate characteristics of the oxidation of disulphide-acids by hydrogen peroxide. G. G. Stoner and G. Dougherty (*J. Amer. Chem. Soc.*, 1941, 63, 1291–1292).—The rates of oxidation of dithiodiacetic, $\alpha\alpha'$ - and $\beta\beta'$ -dithiopropionic, and $\gamma\gamma'$ -dithiobutyric acids by H_2O_2 in H_2O , and dioxan- H_2O mixtures, at 30° and 40° have been measured. W. R. A.

Effect of resonance on reaction velocity. F. H. Westheimer and R. P. Metcalf (*J. Amer. Chem. Soc.*, 1941, 63, 1339–1343).—Et 4-dimethylamino-3:5-dimethylbenzoate (I), m.p. 15° , has been synthesised. The rates of saponification (r) of Et *p*-dimethylamino-, 3:5-dimethyl-, 4-nitro-3:5-dimethyl-, and 4-amino-3:5-dimethylbenzoate (II) and of (I) have been measured and compared with saponification data for the corresponding Et benzoates. The increase in r on introduction of $\cdot\text{NO}_2$ is approx. the same for the methylated as for the unmethylated esters. r for (I) is $>$ r for (II) in accordance with the theory of damped resonance. The smallness of r of *p*- $\text{NH}_2\cdot\text{C}_6\text{H}_4\cdot\text{CO}_2\text{Et}$ relative to EtOBz is attributed to resonance interaction of the NH_2 and CO_2Et groups.

W. R. A.

Kinetics of the reaction between methyl bromide and thio-sulphate ion in water. E. A. Moelwyn-Hughes (*Trans. Faraday Soc.*, 1941, 37, 279–281).—The bimol. reaction $\text{S}_2\text{O}_3^{2-} + \text{MeBr} \rightarrow \text{MeS}_2\text{O}_3^- + \text{Br}^-$ was studied in aq. solution in an apparatus, which is described, designed to eliminate the vapour phase. The abs. velocity of the reaction is 17 times that calc. from simple collision theory. The discrepancy is accounted for by a small electrostatic contribution to the activation energy and the participation of one internal mode of motion. F. L. U.

Reactions between gas and solid. VII. Nitrogenation of calcium carbide and its kinetic discussion. T. Aono (*Bull. Chem. Soc. Japan*, 1941, 16, 91–98).—Study of the kinetics of the reaction between solid CaC_2 and N_2 at 790 – 1008° indicates that the first stage comprises adsorption of the N_2 on the CaC_2 . This is followed by the formation of $\text{Ca}(\text{CN})_2$, the heat of activation of this reaction being 86 kg.-cal. per g.-mol. Finally the $\text{Ca}(\text{CN})_2$ is decomposed into CaCN_2 and C. J. W. S.

Combustion of explosives under increasing pressure.—See B., 1941, I, 376.

Gaseous products of detonation of explosives under various conditions.—See B., 1941, I, 376.

Influence of peracetic acid on the cold-flame oxidation of acetaldehyde. B. V. Aivazov, N. P. Keyer, and M. B. Neumann (*Acta Physicochim. U.R.S.S.*, 1941, 14, 201–222).—The oxidation of MeCHO is autocatalytic, and its rate is greatly increased by the addition of small amounts of AcO_2H . The cold-flame reaction is represented by three zones, the interpretation of which is discussed. The induction period corresponds with the accumulation of AcO_2H up to a crit. concn. at which it undergoes explosive decomp. and promotes the rapid oxidation of MeCHO . The rate of accumulation of peroxide and the shortening of the induction period caused by adding various amounts of AcO_2H are quantitatively described, as with the cold-flame oxidation of C_4H_{10} and Me_2O (A., 1939, I, 616; 1940, I, 221), by equations based on the peroxide theory. The region of explosive decomp. of AcO_2H was explored. F. L. U.

Kinetics of olefine-bromine reaction. III. Influence of different catalysts on the reaction. R. Venkataraman (*Proc. Indian Acad. Sci.*, 1941, A, 13, 259–262; cf. A., 1941, I, 51).—The effect of catalysts on the rate of addition of Br to $\text{CMe}_2\text{CH}\cdot\text{CO}_2\text{H}$ in AcOH has been investigated. BiBr_3 , $\text{C}_6\text{H}_5\text{N}$, SnBr_4 , and SbBr_3 act as positive catalysts when present in sufficient quantities. When present in the same mol.-% with reference to the reactants, the activity decreases in the above order, and with SbBr_3 is almost negligible when the mol.-% is < 20 . The difference in activity indicates the formation of a catalyst-reactant complex, of which the extent of formation, and the stability, vary with the catalyst. When SbBr_3 is added to the reaction mixture there is immediate formation of SbBr_3 . With AsBr_3 there was a decrease in the concn. of "available" Br, which was a function of concn. This can be explained only by the existence of an equilibrium of the type $\text{AsBr}_3 \rightleftharpoons \text{AsBr}_2 + \text{Br}_2$. No negative catalysts have so far been found. A. J. M.

Effect of certain agents on stability of ferrous sulphate solutions. C. L. Huyck (*Amer. J. Pharm.*, 1941, 113, 189–195).—Previous work on the stabilisation of aq. FeSO_4 is reviewed. H_3PO_4 and citric acid (I) are inefficient stabilisers but aq. FeSO_4 in presence of 40% of glucose, alone or with 0.1–0.2% of H_3PO_4 or (I), is stable on exposure to the air at room temp. for 6 months (cf. Tomski and Waller, A., 1939, I, 279). F. O. H.

Oxidation of arsenious oxide by nitric acid. N. Maravalhas (*Rev. Chim. Ind.*, 1941, 10, 93).— KIO_3 is preferred to HCl to counteract the inhibiting action of Hg on the oxidation of As_2O_3 by HNO_3 . F. R. G.

Kinetics of decomposition of diazoacetic ester catalysed by acids in aqueous solution. E. A. Moelwyn-Hughes and P. Johnson (*Trans. Faraday Soc.*, 1941, 37, 282–289).—A detailed study of the decomp. of $\text{CHN}_2\cdot\text{CO}_2\text{Et}$ in presence of aq. HCl and HNO_3 has shown that, except for $[\text{CHN}_2\cdot\text{CO}_2\text{Et}] < 0.01 \text{ M.}$, the unimol. const. with HCl decreases with time owing to removal of the acid, chiefly during mixing. With HNO_3 , which does not react with the ester, good vals. are obtained throughout the decomp., the constancy being unaffected by the initial concn. of ester. The influence of temp. on the catalysis by HNO_3 was studied over the range $373\text{--}318^\circ \text{K.}$, and the catalytic coeff. is calc. F. L. U.

Kinetics of mutarotation of glucose catalysed by hydrogen ion in aqueous solution. P. Johnson and E. A. Moelwyn-Hughes (*Trans. Faraday Soc.*, 1941, 37, 289–292; cf. A., 1941, I, 51).—The reaction was investigated over the range $283\text{--}313^\circ \text{K.}$ and the consts. k_0 and k_H for the uncatalysed and catalysed reactions are evaluated. The excess of activation energy for the catalysed over that for the uncatalysed reaction found is probably only apparent, the true difference being $\sim 4 \text{ kg.-cal.}$ in the other direction. The mol. statistics of the catalysed mutarotation suggest that the unsolvated H ion is the effective agent. F. L. U.

Stages in heterogeneous catalysis. Dehydrogenation reactions. A. Balandin (*Acta Physicochim. U.R.S.S.*, 1941, 14, 223–244).—A theoretical discussion, chiefly from the point of view of the multiplet theory (cf. A., 1929, 519). A reply to Taylor's criticism (A., 1938, II, 176) is included. F. L. U.

Evaluation of the surface area of catalysts of cubic form by the emanation method. J. D. Kurbatov (*J. Physical Chem.*, 1941, 45, 851–860).—The problem of evaluating by the emanation method the surface area of a solid cube in which Ra and Th are uniformly distributed is theoretically discussed and shown to be possible if the % and range of recoil of both types of emanation are known. C. R. H.

Exchange reaction between deuterium and hydrogen on nickel. S. Levina (*Acta Physicochim. U.R.S.S.*, 1941, 14, 294–295).—Contrary to the results of Horiuti and Okamoto (A., 1938, I, 255), the rate coeff. of the exchange reaction between D_2 and H_2 on Ni in aq. NaOH increases from 0.0219 at 0.005N- to 0.0635 at 0.53N- NaOH . F. L. U.

Physical chemistry of hopcalite catalysts. E. C. Pitzer and J. C. W. Frazer (*J. Physical Chem.*, 1941, 45, 761–776).—Laboratory and technical methods of preparing MnO_2 catalysts for the oxidation of CO are discussed. To be active the catalysts must consist of crystallites of such small particles that they are almost amorphous. For an oxide to be a catalyst the reaction between it and CO must proceed with a diminution in free energy and in addition the smallest metal—O distance should lie within the range 1.75–1.85 Å. In addition to MnO_2 , Co_2O_3 and Ni_2O_3 satisfy these conditions and they are consequently all efficient catalysts at 0° . Mainly on theoretical grounds it is suggested that the catalysis involves adsorption of each mol. of CO on two points of the catalyst. C. R. H.

Reactions between gas and solid. VIII. Mechanism of nitrogenation of calcium carbide. T. Aono (*Bull. Chem. Soc. Japan*, 1941, 16, 106–114).—The views of a no. of writers on the mechanism of the reaction between CaC_2 and N_2 are summarised and discussed. It is concluded that there are 4 stages, viz., (1) activated adsorption of N_2 on active centres of CaC_2 ; (2) formation of $\text{Ca}(\text{CN})_2$; (3) decomp. of $\text{Ca}(\text{CN})_2$ to CaCN_2 and C ; (4) autocatalysed repetition of these stages. The various catalysts affect different stages; e.g., C catalyses stage (1), whereas salts catalyse stages (2) and (3). F. J. G.

Two-component gel catalysts containing chromium oxide for aromatisation of *n*-heptane. H. Fehrer and H. S. Taylor (*J. Amer. Chem. Soc.*, 1941, 63, 1385–1386; cf. A., 1941, I, 274).—Two-component gel catalysts of Cr_2O_3 with (i) Cu , Ni , and Pd , (ii) MnO , ZnO , and MoO_3 , and (iii) SiO_2 , ZrO_2 , and SnO_2 , have been studied for the dehydrogenation-cyclisation of *n*-heptane and compared with Cr_2O_3 at 475° . (i) produced increased H content but lower aromatic content; (ii) produced lower olefine content for a standard aromatic content,

whilst with (iii) ZrO_2 and SnO_2 gave catalysts superior to Cr_2O_3 ; SiO_2 increased the surface area of the catalyst without increasing the catalytic activity. ZrO_2 has dehydrogenation-cyclisation activity at 475° . W. R. A.

[Catalytic] synthesis of benzene from carbon monoxide and hydrogen.—See B., 1941, I, 331.

Kinetics of contact catalysts and the industrial background. H. S. Taylor (*Science*, 1940, 92, 469–471). L. S. T.

Electrochemical purification of aluminium in the electrolyte $\text{AlCl}_3\text{--NaCl}$.—See B., 1941, I, 371.

Deposition of antimony on negative battery plates.—See B., 1941, I, 311.

Electrodeposition of titanium and its alloys.—See B., 1941, I, 370.

Rate studies in the electrochemical oxidation of phenol. J. R. Shields and J. Coull (*Trans. Electrochemical Soc.*, 1941, 80, Preprint 7, 61–67).—The overall rate of electrochemical oxidation of PhOH using a graphite or PbO_2 anode can be represented by $-dC/dQ = 0.156C^{0.92}$ in the early stages and by $-dC/dQ = 1.21C^{0.845}$ in the later stages of the reaction ($C = [\text{PhOH}]$ in g. per l., $Q = \text{no. of coulombs/60}$). Formation of quinol, benzoquinone, etc., which are adsorbed by the anode, thereby influencing PhOH diffusion, tends to retard oxidation as the reaction develops. C. R. H.

Electrochemical experiments with maleic acid.—See A., 1941, II, 211.

Chemical action of electric discharges. XXII. Peculiarities of the arc spectra, at high and low frequencies, arising in gaseous mixtures containing hydrocarbons. B. P. Susz, H. Hoefler, and E. Briner (*Helv. Chim. Acta*, 1941, 24, 501–503).—The spectrum of N_2 -hydrocarbon mixtures at low pressures, when subjected to the action of an arc between Cu electrodes, shows lines and bands due to H , C , C_2 , N_2 , N_2^+ , O , Cu , CH , CO , CO^+ , OH , and CN . The spectrum is similar at frequencies of 50 and 10^7 cycles per sec., but the concn. of the emitters is as great with 10 w. energy input at high frequency as it is with 40 w. at low frequency. The Swan bands of C_2 are very strong, suggesting that these particles play an important part in the formation of HCN . The β - and γ -bands of NO , which are very strong in N_2 containing very little O_2 , even in the presence of H_2 , disappear in the presence of hydrocarbons. J. W. S.

Photochemical decomposition of acetone in presence of hexadeuteriodiacetyl. D. S. Herr, M. S. Matheson, and W. D. Walters (*J. Amer. Chem. Soc.*, 1941, 63, 1464–1468).—At $< 60^\circ$ the quantum yield for the near ultra-violet photochemical decomp. of COMe_2 is < 1 and the reaction $\text{Me} + \text{Ac}_2 = \text{COMe}_2 + \text{Ac}$ (i) has been postulated to account for this. To test the importance of this reaction the photolysis of COMe_2 and $\sim 1\%$ ($\text{CD}_3\cdot\text{CO}$) $_2$ (prep. given) at temp. between 25° and 99° has been investigated. At room temp. practically no D was contained in the C_2H_6 formed, and there was no change in the ratio $\text{C}_2\text{H}_6 : \text{CO}$ nor in the quantum yield of C_2H_6 formed. At $> 80^\circ$ the C_2H_6 contained appreciable quantities of D , showing that Me radicals attack the ($\text{CD}_3\cdot\text{CO}$) $_2$ mols. It is concluded that reaction (i) is not of importance in accounting for the low quantum yield. W. R. A.

IX.—METHODS OF PREPARATION.

Olistomerism. A. A. Balandin (*J. Gen. Chem. Russ.*, 1940, 10, 1399–1404).—Theoretical. Reactions in which the same substrates yield the same final products, but via different intermediate stages, are termed olistomeric reactions. R. T.

Rare gases. VI. Compound of xenon with phenol. B. A. Nikitin (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 571–574; cf. A., 1940, I, 158).— Xe and PhOH form the compound Xe_2PhOH (I) having a dissociation pressure (P) of 760 mm. at 4° . P is compared with similar data for the mol. compounds of HCl , H_2S , and HBr with PhOH over the temp. range -30° to 26° . The stability of (I) is approx. 0.3 of that of $\text{H}_2\text{S}_2\text{PhOH}$. The dipole moment is considered of greater consequence in compounds in which the co-ordination no. is 6 rather than 2. W. R. A.

Thermal dissociation of gypsum, and changes in its density at different temperatures. V. I. Serdiukov (*J. Gen. Chem. Russ.*, 1940, 10, 1306–1318).—The d of gypsum rises from

2-856 to 2-942, with rising temp. from 600° to 1100°. Further rise in temp. causes only a very gradual increase in d , up to 1420°, above which d again rises rapidly. The first period is one of structural change in CaSO_4 , without dissociation, whilst the third period is one of formation of solid solutions of CaO in CaSO_4 . Dissociation commences at lower temp. in presence of SiO_2 , with production of $2\text{CaO} \cdot \text{SiO}_2$ and $\text{CaO} \cdot \text{SiO}_2$. R. T.

Decomposition temperatures of some analytical precipitates. Calcium carbonate and lead sulphate. M. L. Nichols and B. E. White (*Ind. Eng. Chem. Anal.*, 1941, 13, 251—256).—The dissociation of CaCO_3 has been studied by the gas saturation method of determining v.p., and the results compared with those obtained by static methods. A similar investigation with PbSO_4 indicated that no appreciable loss in wt. should occur when PbSO_4 is heated in a muffle furnace below 710°, but at 730° a small but definite loss should occur. This has been confirmed by direct determinations of the loss in wt. on heating in Pt crucibles. Heating at 730° for 1–2 hr. introduces no significant error on 1-g. samples. L. S. T.

Yellow-fluorescent form of zinc silicate. H. P. Rooksby and A. H. McKeag (*Trans. Faraday Soc.*, 1941, 37, 308—311).—X-Ray data are recorded showing that yellow-fluorescent materials prepared by rapidly cooling Mn-activated mixtures of ZnO and SiO_2 from ~1500° contain a cryst. Zn_2SiO_4 differing in structure from willemite; the conclusion reached by Fonda (A., 1941, I, 28) is thus incorrect. The same cryst. variety, for which the designation $\beta\text{-Zn}_2\text{SiO}_4$ is proposed, can also be prepared, although in poorer yield, by reaction between ZnO and SiO_2 at ~850°. F. L. U.

Exchange of oxalates with complex trioxalate ions of trivalent metals. F. A. Long (*J. Amer. Chem. Soc.*, 1941, 63, 1353—1357).—The interchange of oxalates between uncombined $\text{C}_2\text{O}_4^{2-}$ ions and complex oxalate ions of Al, Fe^{III} , and Co^{III} has been investigated using C^* . The Al and Fe^{III} compounds show rapid interchange but the Co^{III} compound no interchange. These results accord with the view that in the Co^{III} complex the bonds are primarily covalent, whereas in the Al and Fe^{III} compounds they are ionic. It appears unlikely that the Fe^{III} and Al trioxalate salts would yield a stable optically active ion, but the possibility of a short-lived optically active ion is not excluded. W. R. A.

Indium. II. Hydrolysis of indium trichloride solutions. T. Moeller (*J. Amer. Chem. Soc.*, 1941, 63, 1206—1207).— InCl_3 solutions are acidic, presumably because of the hydrated In ion, $\text{In}(\text{H}_2\text{O})_6^{3+}$. This would hydrolyse to $\text{In}(\text{H}_2\text{O})_5\text{OH}^{2+}$ and H_3O^+ . Hydrolysis consts. have been calc. on this assumption from the variation of p_{H} of InCl_3 solutions (0.0005 to 0.414M.) at 25°. W. R. A.

Lead oxides. IV. Polymorphic transitions by grinding, distortion, and catalytic activity in PbO . V. Compounds of the type PbO_n ($n=1-2$). G. L. Clark and R. Rowan (*J. Amer. Chem. Soc.*, 1941, 63, 1302—1305, 1305—1310; cf. A., 1939, I, 154).—IV. Grinding converts metastable, yellow, orthorhombic PbO into a distorted red PbO having (i) a different X-ray diffraction pattern and (ii) enhanced catalytic activity. The degree of distortion is increased by increased grinding up to 10 hr. Distortion is removed by annealing, rapidly at >400°, slowly at 300°, and not at all at 215°, by liquid air temp., or by ultrasonic vibrations. Since annealing leads to removal of distortion support is given to the theory that distortion is due to a poorly oriented lattice, possibly with atoms missing at random throughout the lattice, owing to the incomplete rearrangement in the transition from orthorhombic to tetragonal.

V. The Pb oxide phase, described by LeBlanc and Eberius, formulated Pb_3O_4 and named "black red lead," has been prepared; it is a mixture of Pb_2O_3 and a new phase PbO_2 . From X-ray data PbO_2 may be monoclinic or triclinic, probably near orthorhombic; its interplanar spacings have been determined but its crystal structure and unit cell determination cannot be deduced from available data. PbO_2 (almost pure) is obtained by absorption of O_2 by normal PbO at 390°, the transition temp. for $\text{Pb}_2\text{O}_3 \rightarrow \text{PbO}_2$. When distorted PbO is used instead of normal, only Pb_2O_3 is obtained. Distorted PbO absorbs O_2 much more rapidly than normal PbO and this is suggested as a more reliable measure of distortion than the catalytic decomp. of H_2O_2 . From an analysis of a powder pattern Pb_2O_3 is tetragonal, with a 5.508, c 5.460 Å., one mol. per unit cell. The effect

of $\text{NH}_2\text{SO}_3\text{H}$ (I) on PbO_2 has been studied in an attempt to prepare PbO_2 of theoretical O content; (I) causes a diminution in the amount of active O, X-ray patterns of Pb_2O_3 are exhibited by the extracted samples, and the amount of Pb_2O_3 increases with increasing time of extraction. The alleged black PbO has been examined by X-ray methods and gives the characteristic pattern for yellow PbO . The black colour is due to a surface effect, probably, as suggested by Applebey *et al.* (A., 1932, 326), due to a film of Pb so finely divided and in such small amount as to be undetected by the X-ray method. W. R. A.

Preparation and properties of lead tetrachloride, hydrochloroplumbic acid, and ammonium plumbichloride. V. F. Postnikov and A. I. Speranski (*J. Gen. Chem. Russ.*, 1940, 10, 1328—1332).—Detailed instructions for prep. of solutions of H_2PbCl_6 (I), of cryst. $(\text{NH}_4)_2\text{PbCl}_6$ (II), and of PbCl_4 are given. The reactions involved are $\text{PbCl}_2 + 2\text{HCl} + \text{Cl}_2 \rightleftharpoons$ (I); (I) + $2\text{NH}_4\text{Cl} \rightleftharpoons$ (II) + 2HCl ; (II) + $\text{H}_2\text{SO}_4 \rightarrow \text{PbCl}_4 + 2\text{HCl} + (\text{NH}_4)_2\text{SO}_4$. R. T.

Fixation of nitrogen as oxide in an induction tube at high temperature.—See B., 1941, I, 351.

Attempted exchange of radiophosphorus between ortho-, pyro-, and meta-phosphoric acids. D. E. Hull (*J. Amer. Chem. Soc.*, 1941, 63, 1269—1272).—No exchange of P^* between H_3PO_4 , $\text{H}_4\text{P}_2\text{O}_7$, and HPO_3 in aq. solutions of various p_{H} occurs in the temp. range 20—100°. Possible reactions, whereby the exchange might be effected, are discussed. HPO_3 can be separated completely from the other two by Ba^{++} , and $\text{H}_4\text{P}_2\text{O}_7$ can be separated completely from H_3PO_4 by Cd^{++} , using for both separations a radioactive indicator method, which is described. W. R. A.

Arsenic salts. I. Formation of copper arsenites in aqueous solutions. G. P. Lutschinski and V. F. Tschurikina (*J. Gen. Chem. Russ.*, 1940, 10, 1425—1431).—The reaction $4\text{NaAsO}_2 + 2\text{CuSO}_4 + 2\text{H}_2\text{O} \rightarrow \text{Cu}(\text{OH})_2 \cdot \text{CuH}_2\text{As}_2\text{O}_6 + 2\text{Na}_2\text{SO}_4 + \text{As}_2\text{O}_3$ takes place at room temp. In the case of boiling solutions the composition of the ppt. depends on the concn. of the substrates. When the $[\text{NaAsO}_2]$ is >23% the product is $\text{Cu}(\text{AsO}_2)_2$, which is hydrolysed to $\text{Cu}(\text{OH})\text{AsO}_2$ in alkaline solution. At $[\text{NaAsO}_2]$ 4—16% the product is CuHAsO_3 and its hydrate, $\text{Cu}(\text{OH})_2 \cdot \text{CuH}_2\text{As}_2\text{O}_6$, whilst at $[\text{NaAsO}_2] < 4\%$ the ppt. has the composition $3\text{CuO} \cdot \text{As}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$. CuO and boiling aq. As_2O_3 react slowly with production of CuAs_2O_4 . R. T.

Reaction of hydrogen sulphide with sulphites. II. J. I. Zilberman (*J. Gen. Chem. Russ.*, 1940, 10, 1257—1265).—The process consists of the following reactions: $2\text{H}_2\text{S} + \text{H}_2\text{SO}_3 \rightarrow 3\text{H}_2\text{SO}$; $\text{H}_2\text{SO} + \text{H}_2\text{SO}_3 \rightarrow \text{H}_2\text{S}_2\text{O}_3 + \text{H}_2\text{O}$; $\text{H}_2\text{SO} + 2\text{H}_2\text{SO}_3 \rightarrow \text{H}_2\text{S}_2\text{O}_6 + \text{H}_2\text{O} + 2\text{H}^+$; $\text{H}_2\text{SO} + \text{H}_2\text{SO}_3 \rightarrow \text{H}_2\text{S}_2\text{O}_4 + \text{H}_2\text{O}$; $\text{H}_2\text{SO} + \text{H}_2\text{SO}_3 \rightarrow \text{H}_2\text{S}_2\text{O}_5 + \text{H}_2\text{O} + \text{H}_2\text{S}$; $\text{H}_2\text{SO} + 2\text{H}_2\text{SO}_3 \rightarrow \text{H}_2\text{S}_2\text{O}_6 + \text{H}_2\text{O} + 2\text{H}^+$; $\text{H}_2\text{SO} + 2\text{H}_2\text{S}_2\text{O}_3 \rightarrow \text{H}_2\text{S}_2\text{O}_6 + \text{H}_2\text{O} + \text{H}_2\text{S}$. The experimental results of Stamm and Goehring (A., 1939, I, 382; 1940, I, 128) are in better accordance with this scheme than with that advanced by these authors. (Cf. A., 1941, I, 19.) R. T.

Preparation and magnetic properties of complex compounds of bivalent chromium. D. N. Hume and H. W. Stone (*J. Amer. Chem. Soc.*, 1941, 63, 1200—1203).—The following have been prepared: *monopyridinochromous acetate*, *chromous anthranilate* and *8-hydroxyquinoline*. The magnetic properties of CrCl_2 and its NH_3 , $(\text{CH}_3)_2\text{NH}_2$, and CNS complexes, and of K chromo- and chromi-cyanides, have been investigated and the bearing of the results on valency is discussed. W. R. A.

Physico-chemical studies of tungsten oxychloride. A. V. Komandin and D. N. Tarasenkova (*J. Gen. Chem. Russ.*, 1940, 10, 1333—1342).—A 3:2 $\text{N}_2\text{-Cl}_2$ mixture passed over WO_2 (1 hr. at 540°) yields chiefly WO_2Cl_2 , together with some WOCl_4 . V.p. data are recorded for WO_2Cl_2 at 196—264°, for WOCl_4 at 100—150° and at 168—214°, for 1:1 and 4:1 $\text{WO}_2\text{Cl}_2\text{-WOCl}_4$ mixtures at 164—278°, and for WO_2Cl_2 and WOCl_4 in SnCl_4 at 25° and 114°. The reaction $2\text{WO}_2\text{Cl}_2 \rightleftharpoons \text{WOCl}_4 + \text{WO}_3$ commences at 250°. R. T.

Rigid purification of chlorine. P. M. Fye and J. J. Beaver (*J. Amer. Chem. Soc.*, 1941, 63, 1268—1269).—A slow low-pressure sublimation-crystallisation process for the rigorous purification of Cl_2 , which depends on continuous removal of impurities non-condensable at -196°, followed by (i) freezing at -196° and pumping (10^{-6} mm. pressure) for 1 hr.,

(ii) distillation from a quartz storage cell (-80°) to a liquid-solid mixture of EtBr (-119°) with continuous pumping; with a pressure of <1 mm. Hg the rate of evaporation was sufficient to keep the Cl_2 solid (-101.6°). Impurities in Cl_2 are detectable by utilising the photochemical formation of COCl_2 , which is retarded by impurities. W. R. A.

Removal of chlorides and sulphates by synthetic resins.—See B., 1941, I, 350.

Radioactive organic bromine compounds.—See A., 1941, II, 210.

Ferric thiocyanate. S. M. Edmonds and N. Birnbaum (*J. Amer. Chem. Soc.*, 1941, 63, 1471–1472).—The results of Bent and French (A., 1941, I, 210) for the existence of the FeCNS^{2+} ion are confirmed using a balance type photoelectric colorimeter. W. R. A.

Mechanism of formation of $\text{Co}[\text{Hg}(\text{CNS})_4]$. L. M. Kulberg and E. J. Matenko (*J. Gen. Chem. Russ.*, 1940, 10, 1210–1212).—The ppt. obtained from aq. solutions containing Hg^{2+} , Co^{2+} , and CNS^- is $\text{Co}[\text{Hg}(\text{CNS})_4]$, but not $\text{Hg}[\text{Co}(\text{CNS})_4]$, as is shown by absorption spectrum data, and by a study of conditions of formation of the salt in presence of excess of one of the salts involved. R. T.

X.—ANALYSIS.

Permanency of solutions used in volumetric analysis. J. R. Pound (*Chem. Eng. Min. Rev.*, 1941, 33, 138–139).—Data are given showing the change in normality which occurs when standard solutions of acids, alkalis, oxidising and reducing agents are kept in ordinary glass-stoppered bottles for 1–2 years in the dark. $\text{K}_2\text{Cr}_2\text{O}_7$ solutions are the most stable of the common reagents, and alkali solutions the least stable. A. R. P.

Use of non-aqueous solutions in polarography. A. M. Zanko and F. A. Manusova (*J. Gen. Chem. Russ.*, 1940, 10, 1171–1176).—The height of the polarographic wave in org. solvents is $<$ in H_2O , at equal concns., but \propto concn. of the substance undergoing reduction. R. T.

Interferences occurring with selected drop reactions. L. Smith and P. W. West (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 271–275; cf. A., 1940, I, 377).—Interferences, many of them not previously recorded, occurring with selected drop reactions for 38 elements are tabulated. Interferences are labelled positive when a test is obtained in absence of the element sought, and negative when the test for an element present is inhibited. The drop reactions are applied after the sample of the unknown has been treated with $\text{Na}_2\text{CO}_3 + \text{Na}_2\text{O}_2$. This method accomplishes an almost equal division of the more common elements into two groups, and reduces the no. of possible interferences. L. S. T.

Quantitative drop analysis. XIV. Potentiometric determination of chloride. XV. Determination of potassium. B. Cunningham, P. L. Kirk, and S. C. Brooks (*J. Biol. Chem.*, 1941, 139, 11–19, 21–28).—XIV. The sample, containing 30–0.5 μg . of chloride, is measured into a titration dish, sufficient $\text{N-H}_2\text{SO}_4$ to bring the acid concn. to 0.3–0.4N. is added, and a Ag electrode pair is introduced. Equal additions of 0.01N- AgNO_3 are made, and potential readings are taken after ≤ 30 sec. equilibration periods. In determining the Cl^- content of plasma, the latter can be diluted and titrated directly, as plasma-proteins do not interfere with the titration.

XV. The solution, containing K as KCl , is evaporated to dryness, and the KCl , NaCl , CaCl_2 , and MgCl_2 are dissolved in 80% EtOH. K is then pptd. by addition of 4% H_2PtCl_6 in 80% EtOH. After keeping for 12 hr. the K_2PtCl_6 is collected on an asbestos pad formed on the end of a filter-stick, washed twice with 0.05 ml. of 80% EtOH saturated with K_2PtCl_6 , and then with 95% EtOH saturated with K_2PtCl_6 . The ppt. is then dissolved in warm H_2O , a drop of 0.2M- HCO_2Na added, and the solution evaporated to reduce the K_2PtCl_6 . The Cl^- is then titrated with AgNO_3 . The method is suitable for determining K in biological fluids. J. W. S.

Removal of thiocyanate in the detection of halides. D. Hart and R. Meyrowitz (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 237; cf. A., 1940, I, 370).—The Ag halide ppt. is decomposed by boiling with $(\text{NH}_4)_2\text{S}$, the Ag_2S filtered off, and the H_2S and NH_3 are removed by boiling. The solution is acidified with dil. HNO_3 , and made alkaline (nitrazine) by means of dil.

Na_2CO_3 . Most of the CNS^- and I^- is removed by addition of $\text{m-Pb}(\text{NO}_3)_2$ and centrifuging. CNS^- and I^- are confirmed in the supernatant liquid by addition of $\text{Fe}(\text{NO}_3)_3$ and CCl_4 in dil. HNO_3 . The remainder of the solution is acidified with HNO_3 , NaNO_2 is added, and the I^- and CNS^- are removed by boiling. Br^- is then confirmed in this solution by means of aq. KMnO_4 and CCl_4 . Br^- is removed by boiling with HNO_3 , and Cl^- detected with AgNO_3 . L. S. T.

Determination of dietary fluorine. J. F. McClendon and W. C. Foster (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 280–283).—A spectrophotometric study of the Th⁺⁺⁺-alizarin- F^- reaction shows that the Th solution should be standardised at the exact p_{H} , ionic strength, and temp. at which the F^- is titrated. The p_{H} should lie between 3 and 3.5; at $p_{\text{H}} > 3.5$ there may be error due to free alizarin in the red form, and at $p_{\text{H}} < 3.5$ the Th lake does not show its full colour. Interference by Na^+ may be due to the formation of $\text{NaF} \cdot \text{ThF}_4$, pptn. of the lake, and the effect of change in ionic strength on alizarin. Details of procedure, apparatus for ashing large amounts of org. matter in O_2 in a closed system to prevent loss of F by volatilisation, and a micro-still for separating H_2SiF_6 in a single distillation are described. The method is of val. in determining 1 μg . of F in foodstuffs. Data showing the recovery of F added to rat's bones and teeth and of F in rat's diet, teeth, and bones are recorded; 2.5–10 μg . of added F may be recovered with an error of 5%. L. S. T.

Titrimetric determination of semi-micro-amounts of sulphates. R. Belcher and A. L. Godbert (*Analyst*, 1941, 66, 289–290).—There is no advantage in using HClO_4 instead of HCl for acidifying the solution in which the SO_4^{2-} is pptd. with CaCl_2 or for dissolving the BaCrO_4 (in which form the excess of Ba^{2+} is pptd. for volumetric determination), and it is immaterial whether the FeSO_4 or $\text{KI-Na}_2\text{S}_2\text{O}_8$ method is used for titrating the CrO_4^{2-} (cf. Gibson and Caulfield, A., 1935, 1258; Manov and Kirk, A., 1937, I, 324). A. R. P.

Determination of pyritic sulphur in coal.—See B., 1941, I, 326.

Ferric chloride as a permanent standard in the colorimetric determination of nitrate. G. V. L. N. Murty (*Proc. Indian Acad. Sci.*, 1941, 13, A, 116–118).—0.08N- FeCl_3 can be satisfactorily employed as a permanent standard in the colorimetric determination of NO_3^- by the α -naphtholsulphonic acid method. H. W.

Stylometric determination of silicon in steel, brass, and duralumin.—See B., 1941, I, 369.

Determination of hydrocyanic acid by the phthalin method. R. I. Nicholson (*Analyst*, 1941, 66, 189–192).—The solution containing 0.01–0.1 mg. of HCN is treated with 0.5N- NaOH until an excess of 1.5 ml. is present, cooled, diluted to 45 ml., treated with 1 ml. of 0.2% *o*-cresolphthalin (I) in 33% EtOH and 1 ml. of 0.15% aq. CuSO_4 , shaken in a stoppered flask for exactly 5 min., treated with 2 ml. of 5% aq. Na_2SO_3 containing 0.24% of $\text{N}(\text{C}_2\text{H}_5\text{OH})_3\text{HCl}$, and diluted to 50 ml. The resulting red colour due to oxidation of (I) to the Na salt of the corresponding phthalein is compared with that of alkaline solutions containing known amounts of cresol-red. In the analysis of plant material the HCN is distilled by means of a current of CO_2 -free air into 10 ml. of 0.5N- NaOH , the material being first incubated with emulsin at p_{H} 4.6. A. R. P.

Diazoaminoazo-compounds.—See A., 1941, II, 220.

Determination of lead permanganometrically (Low's method). K. Neelakantam (*Proc. Indian Acad. Sci.*, 1941, 13, A, 108–115; cf. A., 1940, I, 445).—For dissolving ppts. of PbC_2O_4 in the determination of Pb and for the titration of the liberated $\text{H}_2\text{C}_2\text{O}_4$ with KMnO_4 , the use of HCl is permissible of the concn. is $> 0.5\text{N}$. Use of HCl in place of H_2SO_4 obviates the difficulties due to the occlusion of $\text{H}_2\text{C}_2\text{O}_4$ in Low's method and the complications in the KMnO_4 titrations arising from use of HNO_3 . Quant. pptn. of Pb as PbC_2O_4 does not require the use of 60% AcOH ; 5–6% of AcOH suffices. HNO_3 must not be used. H. W.

Permanganate titration of thalious salts. R. S. Beale, A. W. Hutchison, and G. C. Chandlee (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 240–242).—Electrometric titrations at 65–70° in 0.8N- HCl indicate that detectable amounts of Tl^+ are oxidised by atm. O_2 during the time required for titration. In an atm. of N_2 under otherwise similar conditions, results are satisfactory. Titrations to a visual end-point with KMnO_4 at

room temp. in solutions 1.2N. with respect to HCl and to NaF or $\text{KF} \cdot 2\text{H}_2\text{O}$ are satisfactory for 0.006—0.1 g. of Ti^+ per 60 ml. A faint brown coloration appears as the titration progresses, but may be disregarded. Replacement of HCl by an equiv. amount of H_2SO_4 retards the rate of reduction of the KMnO_4 , and when approx. equiv. amounts of the two acids are present the end-point becomes uncertain. With $[\text{NaF}] < 0.2\text{N.}$ or high acid concns. results are low. Since MnO_4^- in presence of F^- is reduced to Mn^{+++} , the normality of the KMnO_4 so used is 0.8 of that obtained by standardisation against $\text{C}_2\text{O}_4^{--}$. L. S. T.

Silver reductor in analytical chemistry [Determination of traces of iron.] E. E. Halls (*Ind. Chem.*, 1941, 17, 173—174).—Ag. pptd. from aq. AgNO_3 by means of sheet electrolytic Cu, is used in an apparatus of the Jones reductor type; it is kept covered by N-HCl when not in use. Traces of Fe are determined by evaporating the solution to 50 ml., adjusting the acidity to N. with respect to HCl, passing the solution through the reductor at a rate of 30 ml. per min., washing with 150 ml. of N-HCl , and, even in presence of Ti and Mn, titrating with $\text{Ce}(\text{SO}_4)_2$ [prep. from $\text{Ce}(\text{C}_2\text{O}_4)_2$ described], using $\alpha\text{-Fe}^{+++}$ -phenanthroline complex as indicator. The standardisation of the $\text{Ce}(\text{SO}_4)_2$ electrometrically, or volumetrically by means of $\text{Na}_2\text{C}_2\text{O}_4$, and a back titration with FeSO_4 (+ H_2SO_4) is detailed. The reductor is regenerated by filling it with 0.2N- H_2SO_4 and placing a Zn rod in contact with the Ag and AgCl , which is reduced rapidly. Fe impurities in brasses, Sn-bronzes, Cu, Al-bronzes, etc. can be rapidly and accurately determined by the above method after a preliminary separation of the Fe and Al, and dissolution in HCl. L. S. T.

Internal electrolysis. VI. Determination of small quantities of cobalt in presence of zinc. J. G. Fife (*Analyst*, 1941, 66, 192—193).—The anolyte consists of 100 ml. of a solution containing 5 g. of Zn as ZnCl_2 and 20 ml. of aq. NH_3 (d 0.88) above that required to redissolve the $\text{Zn}(\text{OH})_2$, whilst the catholyte consists of 300 ml. of a similar solution to which is added the solution containing the Co and 2 g. of $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$ or 0.2 g. of $\text{N}_2\text{H}_4 \cdot 2\text{HCl}$. The anode consists of Zn strips joined externally by a Cu wire to a Pt cathode, and the electrolysis is carried out at 60—75° for 15—60 min. A. R. P.

XI.—APPARATUS ETC.

Precision cryostat for the range —35° to 25°. Improved electrical circuit and a new expansion valve. E. E. Roper (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 257—259).—Improvements in the apparatus described previously (A., 1940, I, 234) are illustrated. L. S. T.

Simple photometer for the examination of X-ray films. A. H. Jay (*J. Sci. Instr.*, 1941, 18, 128—130).—The simple photometer described and figured can be used for identifying line patterns or making accurate intensity measurements. Data relating to the determination of the at. scattering factor of Al are recorded. A. A. E.

Measurement of streaming double refraction in the presence of a large double refraction due to the apparatus. A. Frey-Wyssling and E. Weber (*Helv. Chim. Acta*, 1941, 24, 278—288).—The usual forms of apparatus for measuring streaming double refraction produce a double refraction through reflexion at the walls and strain in the windows; this may be > the small streaming double refraction effect. The orientation of the two effects is usually different, and the method of calculating the streaming double refraction from the observed double refraction curve and the apparatus curve is discussed. J. W. S.

Equipment for the double variation method of refractive index determination. I. Improved stage cell. II. Variable temperature control apparatus. V. A. Vigfusson (*Amer. Min.*, 1940, 25, 763—766). L. S. T.

Particle size measurement by the X-ray method. F. W. Jones (*J. Sci. Instr.*, 1941, 18, 157—158).—A brief review. For particle size of 100 Å., reproducibility is $\sim \pm 10\%$. The abs. accuracy is probably much lower; it decreases for smaller as well as for larger particle size. A. A. E.

Experimental technique in the study of alloys by X-rays. O. S. Edwards and H. Lipson (*J. Sci. Instr.*, 1941, 18, 131—133).—Difficulties may be surmounted by the use of screens

between the specimen and the film, and by the use of large concns. Data relating to β -filters for the radiations from 14 targets are tabulated. Unsatisfactory photographs may often be due to deposition of W from the filament on targets and windows. A. A. E.

X-Ray crystal photography at low temperatures. K. Lonsdale and H. Smith (*J. Sci. Instr.*, 1941, 18, 133—135).—A stream of liquid O_2 is allowed to flow over the specimen which is enclosed in a thin Cellophane tube or is coated with Cellophane solution. Any suitable ordinary spectrometer may be used. A. A. E.

Measurement of stress by X-rays. D. E. Thomas (*J. Sci. Instr.*, 1941, 18, 135—138).—The procedure described is an application of the precision measurement of crystal lattices by the back reflexion method; comparison material is not employed. The specimen is first etched to remove surface abnormalities and tool effects. Serious strains can be detected and the direction of the stress verified. Apparatus is briefly described. A. A. E.

Deviation of lattice spacings from Debye-Scherrer photographs. H. Lipson and A. J. C. Wilson (*J. Sci. Instr.*, 1941, 18, 144—148).—Various methods of mounting the film in the camera are discussed in relation to the type of film obtained and to their application in cameras of 19 cm. diameter. Measurement of a photograph obtained with Al and the calculation of the lattice parameter are described. A. A. E.

Photometry of X-ray crystal diffraction diagrams. J. M. Robertson and R. H. V. M. Dawton (*J. Sci. Instr.*, 1941, 18, 126—128).—Instruments are briefly described and difficulties involved in the procedure are outlined. In the Dawton scan photometer (not yet described in detail) the X-ray film is scanned by a small spot of light which is passed into a photocell followed by a single stage of valve amplification. The instrument is simple, has no reciprocating parts, and gives reproducible results. A. A. E.

Large recording spectrograph for the infra-red to 15 μ . E. D. McAlister, G. L. Matheson, and W. J. Sweeney (*Rev. Sci. Instr.*, 1941, 12, 314—319).—The spectrograph has a resolving power equiv. to the theoretical from 6 to 15 μ , using a large rock-salt prism. D. F. R.

Focussing X-ray monochromators. C. S. Smith (*Rev. Sci. Instr.*, 1941, 12, 312—314).—The technique of bending and grinding rock-salt crystals and their use in focussing monochromators are fully described. D. F. R.

Monochromatic source of mercury resonance radiation. L. B. Thomas (*Rev. Sci. Instr.*, 1941, 12, 309—312).—The radiation obtained by the lamp is 99.5% λ 2537; the line half-breadth is 20% > the ideal Doppler half-breadth at room temp. D. F. R.

Infra-red absorption cell for volatile liquids. L. Gildart and N. Wright (*Rev. Sci. Instr.*, 1941, 12, 204—205).—The cell has rock-salt windows and is capable of sealing against a pressure of 20 lb. per sq. in. This degree of sealing is obtained by using Pb gaskets with their surfaces amalgamated with Hg. D. F. R.

Reflexion method of measuring optical and electrical constants at ultra-high radio frequencies. L. S. Palmer and G. R. Forrester (*Proc. Physical Soc.*, 1941, 53, 479—489).—A method of determining some of the electrical and optical properties of various substances such as soils, H_2O , etc., for wireless waves ~ 70 —80 cm. length is described. Measurements with clay soils with different moisture content show that n increased from 2.6 to 3.6, ϵ increased from ~ 5 to 11, and electrical conductivity increased from 1.5×10^9 to 1.8×10^9 e.s.u. as the moisture content of the clay increased. The frequency used was 407×10^6 cycles. N. M. B.

Device for measuring the extinction angle [of crystals]. H. Inuzuka (*Amer. Min.*, 1940, 25, 735—737).—The apparatus described consists of a light-receiving chamber with a Cs photo-electric cell, an amplifying tube with high resistance, a battery box, and a micro-ammeter. The extinction angle of a crystal can be measured to within $\pm 30'$. L. S. T.

Determination of extinction angles in augite and hornblende with the universal stage according to the method of Conrad Burri. J. C. Haff (*Amer. J. Sci.*, 1941, 239, 489—492).—The method, which is described, is quicker and more accurate than the usual thin-section technique. L. S. T.

Application of the ionoscope to the observation of ionising particles. G. Wataghin (*Ann. Acad. Brasil. Sci.*, 1941, 13, 15).—The possibility of employing a television pick-up tube to visualise ionising particles is discussed. F. R. G.

Motor-driven ionisation spectrometer. M. E. Jefferson and S. B. Hendricks (*Rev. Sci. Instr.*, 1941, 12, 199–203).—Precision ball bearings replace the usual conical bearing for the coaxial rotation of the chamber and crystal. The angular scales are projected for ease of observation. A record of the ionisation intensity is obtained by manually tracing the movement of a galvanometer mirror reflexion on to a strip of moving paper. D. F. R.

Directional Geiger counter. H. G. Stever (*Physical Rev.*, 1941, [ii], 59, 765).—The counter consists of an ordinary Geiger counter with glass beads on the wire dividing the counter into sections. The beads stop the spread of the discharge along the wire. Data on the action of the counter are reported and discussed. N. M. B.

Geiger-Müller counters. C. G. Montgomery and D. D. Montgomery (*J. Franklin Inst.*, 1941, 231, 447–467, 509–545; cf. A., 1940, I, 306, 376).—A comprehensive review of the methods of construction and application of counters. A bibliography of circuits for use in conjunction with counters is given. A. J. M.

Proportional counters. I. M. E. Rose and S. A. Korff (*Physical Rev.*, 1941, [ii], 59, 850–859).—A theoretical and experimental investigation of the amplification properties is reported. The theory is based on a discharge mechanism in which the amplification is due to electron avalanches. Results agree except for large A concn. ($<50\%$ at 10 cm. Hg total pressure) and low total pressure (>5 cm., with a mixture containing 90% CH_4), in which cases the measured amplification factor rises very rapidly. This unstable behaviour is characteristic of monat. and/or diat. gas mixtures. An explanation of the difference in amplification properties of the polyat. and simpler type gases is proposed, and is supported by experiment and by available data. N. M. B.

Detection of elementary particles. I. M. D. de Souza Santos (*Ann. Acad. Brasil. Sci.*, 1941, 13, 63–67).—A counter is described in which by employing a mosaic of detectors the trajectory of an ionised particle can be followed by a scanning method. F. R. G.

Vacuum tube relay. E. J. Serfass (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 262–263).—The relay described consists of a vac. tube, four resistors, a condenser, and a commercial relay. Outstanding features are small size, and the use of a vac. tube, the filament of which operates directly from a 110-v. power line. L. S. T.

Anemometry. P. A. Sheppard (*Proc. Physical Soc.*, 1941, 53, 361–390).—A crit. and historical survey showing the way in which physical principles have been successively applied in the development of apparatus, with notes on the characteristic features of the more important instruments in the several classes of anemometer. N. M. B.

Sensitive flame. E. N. da C. Andrade (*Proc. Physical Soc.*, 1941, 53, 329–355).—Guthrie lecture. A detailed illustrated description of experiments with H_2O -into- H_2O jets, theory, and mathematical treatment leading to an explanation of sensitive flames. N. M. B.

Modified Haldane gas analyser for analysis of mixtures with 100% absorbable gas. H. C. Bazett (*J. Biol. Chem.*, 1941, 139, 81–89).—The modified Haldane gas analysis apparatus described permits analysis of >16 -ml. samples of gas which is 100% absorbable. The main 16-ml. burette has 4 ml. graduated to 0.01 ml., and is connected through a T-tap with a subsidiary 12.5-ml. burette, which can be used to store N_2 for use in making up the vol. in the main burette as gas is absorbed. Alternatively samples of gas >28.5 ml. can be analysed if the absorbable gas is $>57\%$ of the total. J. W. S.

Precision method for the determination of mol. wt. H. P. Cady and M. J. Rarick (*J. Amer. Chem. Soc.*, 1941, 63, 1357–1360).—With the apparatus described the flotation effect of a gas or vapour on a sealed body of known vol. is measured at a temp. ($\sim 200^\circ$) automatically adjusted to the momentarily existing atm. pressure in such a manner that a const. gaseous density is maintained. An accuracy of 0.01 unit is claimed. W. R. A.

Separation of the zones of absorption of colourless substances in chromatographic analysis by determination of the dielectric constant. G. V. Troitzki (*Biochimia*, 1940, 5, 375–380).—A change in ϵ of the column at the zones of adsorption can be observed. A. L.

Systematic determination of crystal orientation. J. Thewlis (*J. Sci. Instr.*, 1941, 18, 148–150).—The basis of the graphical method described is the representation of either the crystallographic indices or the direction cosines of all directions in a crystal by the ordinates and abscissæ of a graph, on which curves of const. angle are drawn for each crystallographic plane considered. General formulæ for the determination of orientation by calculation are also given. Both the method and the formulæ are applicable to all crystal systems. A. A. E.

Apparatus for measurement of small absorptions or evolutions of gas in a closed system. G. Barr (*J.C.S.T.*, 1941, 60, 171–173).—When small changes occur in the mass of gas in a closed system, they may conveniently be measured by a manometer of which the outer arm communicates with a dummy bulb instead of with the open air. This method eliminates corrections for barometric changes, reduces the error arising from imperfect temp. control, and allows the use of a shorter manometer if tests are to be made at temp. other than that of filling. Apparatus is described with which marked differences in the absorption of O_2 by different samples of rubber at 50° could be detected in 6 hr. The method of calculating absorption from the manometer readings is explained.

Purification of radon. P. A. Macdonald and M. S. Margoliese (*Rev. Sci. Instr.*, 1941, 12, 320–325).—A Rn plant of simple design and construction is described. It has worked satisfactorily for 5 years. D. F. R.

Mouth-controlled valve for compressed air in glass blowing. J. L. Allison (*Rev. Sci. Instr.*, 1941, 12, 212–213).—The compressed air is passed through a small glass Venturi, into which is sealed a side arm leading to the glass work to be blown. A rubber diaphragm, operated by air pressure from the mouth, opens or closes the exit of the Venturi and thus produces a pressure $<$ or $>$ atm. inside the glass work. D. F. R.

Device for continuous liquid-liquid extraction. Adaptation for the determination of morphine. J. R. Matchett and J. Levine (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 264–265).—The apparatus described and illustrated obviates the need for disconnecting apparatus for the withdrawal of samples or for stirring. The device is particularly suited to the extraction of morphine from an ammoniacal solution by means of a mixture of C_6H_6 and Pr^βOH , for which details are given. L. S. T.

Perforated plate columns for analytical batch determinations. C. F. Oldershaw (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 265–268).—The all-glass apparatus described and illustrated has a low operating holdup per theoretical plate and a negligible non-drainable holdup, with a high capacity or reflux rate. It is suitable for the analysis of hydrocarbon mixtures. Data illustrating performance and efficiency are recorded. L. S. T.

Electrodialyser. F. E. Brauns (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 259).—An electrodialyser which permits dialysis of amounts of liquids larger than usual in a relatively short time is described and illustrated. L. S. T.

XIII.—GEOCHEMISTRY.

Copper content of the hot springs of Yunohanazawa, Hakone, Kanagawa prefecture, and that of the hot springs of Osoreyama, Aomori prefecture. [Determination of copper.] K. Kuroda (*Bull. Chem. Soc. Japan*, 1941, 18, 69–74).—For the polarographic determination of Cu in mineral H_2O the sample (500 c.c.) is boiled with HNO_3 to oxidise Fe^{II} , made alkaline with aq. NH_3 , and treated with saturated aq. $(\text{NH}_4)_2\text{CO}_3$ (5 c.c.). The ppt. is separated, redissolved in dil. HNO_3 , and reprecipitated with NH_3 and $(\text{NH}_4)_2\text{CO}_3$. The combined filtrates are acidified with HNO_3 and evaporated to dryness. The residue is dissolved in HNO_3 , adjusted to p_H 3, and extracted with 10-c.c. portions of dithizone in CCl_4 until the CCl_4 layer remains green. The combined extracts are treated with conc. HNO_3 (10 c.c.) and NaNO_3 (0.01 g.) and evaporated

to dryness. The residue is dissolved in 10 c.c. of a solution containing 170 g. of NaNO_3 and 200 c.c. of 2% gelatin solution in 1800 c.c. of H_2O , and examined polarographically. Data for the Cu content of the H_2O from various Japanese hot springs are recorded. J. W. S.

Geochemical indications for the presence of borates. I. B. Feigelson (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 592—595).—In ocean H_2O the H_3BO_3 :Br ratio is 0.95. In any region where this val. is exceeded borate exploration should prove profitable and prospecting in the Inder elevation and in the Manguishlak peninsula is recommended. W. R. A.

Flow structure in the Lubbock meteorite, Lubbock, Texas. W. A. Waldschmidt (*Amer. Min.*, 1940, 25, 528—533).—The internal structure of this aërolite shows the effects of flowage and brecciation. These are indicated by the alignment of metallic and non-metallic mineral particles along flowage lines, by an intricate network of small veinlets of Ni-Fe and pyrrhotite, and by veinlets of Ni-Fe in a "horse-tail" arrangement. The flow structure and brecciation probably occurred before flight. L. S. T.

Radioactive determination of the relative abundance of the isotope ^{40}K in terrestrial and meteoritic potassium. W. C. Schumb, R. D. Evans, and W. M. Leaders (*J. Amer. Chem. Soc.*, 1941, 63, 1203—1205).—KCl was separated from a sample of Pultusk meteorite and its β -activity was compared with that of a terrestrial sample, both specimens being spectroscopically of high purity. No difference in the amount of ^{40}K in the two specimens was observable, indicating no difference in age. W. R. A.

The Gibeon shower of meteoritic irons in South-West Africa. L. J. Spencer (*Min. Mag.*, 1941, 26, 19—35).—The presence of large masses of Ni-Fe in Great Namaqualand has been known since 1836, and a preliminary chemical analysis was given by Herschel in 1838. The "Bethany" and "Lion River" masses had evidently been transported from the Gibeon district, whence >50 masses with a total wt. of >16 tons have been removed. These masses have in common a fine octahedral structure and contain ~8% of Ni. New finds are described from Kameelhaar farm, Gibeon (I), and Kamkas farm, Maltahöhe (II). Mass (I) shows the conjunction of two large crystal individuals, one of which is remarkable in showing structure directions parallel to cube faces as well as octahedron faces, there being seven line directions in the Widmanstätten pattern. In mass (II) the octahedral structure is partly obliterated by granulation of the kamacite, indicating a heat-treatment before the meteorite reached the earth's atm. Analysis [(Miss) H. Bennett] gave: (I) Fe 92.38, Ni 7.68, Co 0.30, Cu 0.006, S nil, P 0.05, insol. 0.03, total 100.45; (II) Fe 91.63, Ni 7.93, Co 0.55, Cu 0.008, S nil, P 0.04, insol. 0.01, total 100.17. L. J. S.

Hydrozincite from Narlarla, Western Australia. R. T. Prider (*Min. Mag.*, 1941, 26, 60—65).—Hydrozincite as white or pink, earthy masses is abundant in the oxidised Pb ores together with ZnCO_3 . Optical data are given for the minute lath-shaped crystals. Analysis [M. Crabtree], CO_2 15.19, ZnO 62.10, SiO_2 1.15, Al_2O_3 1.80, Fe_2O_3 2.64, MgO 0.04, CaO trace, CuO 1.75, PbO 3.96, CoO 0.09, NiO 0.13, SO_3 0.01, $\text{H}_2\text{O} + 10.17$, $\text{H}_2\text{O} - 0.96$, total 100.04, is interpreted as a mixture of limonite, allophane, cerussite, and hydrozincite for which a new formula is deduced as $3\text{ZnCO}_3 \cdot 4\text{Zn}(\text{OH})_2$, with slight replacement of Zn by Cu, Ni, and Co. L. J. S.

Metasomatism in the basalt of Haddenrig quarry, Kelso. S. I. Tomkeiff (*Min. Mag.*, 1941, 26, 45—59).—Olivine-basalt grades through metabasalt to potash-spilitite, detailed chemical analysis of these rocks showing an increase in K_2O , CO_2 , and H_2O , with a decrease in Na_2O . Carbonates, as calcite, ankerite, and ferrodolomite, are increasingly present and also from veins in the rocks. A triangular diagram CaCO_3 — MgCO_3 — FeCO_3 shows the composition of 78 analyses of vein carbonates collected from the literature. L. J. S.

Dolomites of Divrik, Turkey. M. Gysin (*Arch. Sci. phys. nat.*, 1940, [v], 22, Suppl., 242—244).—Microscopical examinations of six samples are described. The three chemical analyses recorded show that the yellow limestones of this locality are dolomites, more or less argillaceous, siliceous, or tourmaliniferous. L. S. T.

Crystal structure of tellurite, TeO_3 . T. Ito and H. Sawada (*Z. Krist.*, 1939, 102, 13—25).—Oscillation and Weissenberg

photographs show that the unit cell, containing 8 mols., has a 5.50, b 11.75, c 5.59 Å. ($a:b:c = 0.467:1:0.476$); space-group V_{12}^h ($Pcab$). At. parameters, determined partly by ionisation spectrometer measurements, give a structure closely similar to that of brookite and consisting of chains of deformed octahedra of O atoms surrounding Te. Covalent Te-Te linkings probably join pairs of these chains together, and link the paired chains into bands or sheets parallel to (010).

A. J. E. W.
Structure of libethenite, $\text{Cu}_2(\text{OH})\text{PO}_4$. H. Heritsch (*Z. Krist.*, 1939, 102, 1—12).—Weissenberg and rotation photographs indicate a unit cell containing 4 mols., with a 8.43, b 8.08, c 5.90 Å. ($a:b:c = 1.04:1:0.730$); space-group D_{32}^h ; the previously-accepted horizontal axes are interchanged (cf. A., 1938, I, 501). At. parameters show that libethenite is structurally analogous to andalusite, adamine, and olivenite (cf. *ibid.*, 421; A., 1939, I, 12). The structural units are deformed PO_4 tetrahedra and $\text{CuO}_4(\text{OH})_2$ octahedra, and pseudotrigonal $\text{Cu}(\text{OH})\text{O}$, bipyramids. A. J. E. W.

Lead ratio of a crystal of monazite from the Gaya district, Bihar. T. C. Sarkar (*Proc. Indian Acad. Sci.*, 1941, 13, A, 245—248).—The Pb ratio of a crystal of monazite (0.123) yields an approx. age (corr.) of 875×10^6 years, corresponding with the upper limit of the Middle Pre-Cambrian for the parent pegmatite. W. R. A.

Classification of natural phosphates, arsenates, and vanadates. H. Strunz and J. Schroeter (*Z. Krist.*, 1939, 102, 71—78).—A comprehensive classification based on composition and structural relationships, restricted largely to anhyd. minerals, is proposed. An extensive bibliography is appended. A. J. E. W.

Significance of disseminated metallic sulphides in sedimentary rocks. F. M. van Tuyl (*Science*, 1940, 92, 579).—Attention is directed to the existence of sphalerite, chalcopyrite, and millerite in geodes at certain horizons of Mississippian age in south-eastern Iowa and adjacent areas in Illinois and Missouri, and to the possible significance of such occurrences in connexion with the origin of the Mississippi Valley Pb and Zn ores (cf. A., 1941, I, 62). L. S. T.

Minerals from S. California. II. J. Murdoch and R. W. Webb (*Amer. Min.*, 1940, 25, 549—555; cf. A., 1938, I, 481).—Inyoite crystals from Death Valley; celestine and barite nodules from Avawatz mountains; calcite nodules from Mojave Water Camp, San Bernardino Co.; sand calcite crystals, Red Rock Canyon, Kern Co.; rhodonite, Cajon Pass, San Bernardino Co.; axinite from Erskine Creek, Piute Mountains, and Rademacher-Terese, Kern Co.; garnet and epidote near Daggett, San Bernardino Co.; and fayalite in spheralites from Inyo Co., are described. L. S. T.

Sterrettite, a new mineral from Fairfield, Utah. E. S. Larsen, 3rd, and A. Montgomery (*Amer. Min.*, 1940, 25, 513—518).—Sterrettite, orthorhombic, $a:b:c = 0.8662:1:0.5325$, a_0 8.90, b_0 10.20, c_0 5.43 Å. (all ± 0.02 Å.), $a_0:b_0:c_0 = 0.872:1:0.532$, V_0 493 Å.³, mol. wt. 705, space-group $P2_12_12_1$, D_{32}^h , hardness 5, ρ 2.36, d 1.572, β 1.590, n_x 1.601 (all ± 0.003), contains $\text{Al}_6(\text{PO}_4)_4(\text{OH})_5 \cdot 5\text{H}_2\text{O}$ per unit cell, and occurs in cavities in pseudowavellite in the variscite deposit near Fairfield. A chemical analysis [F. A. Gonyer] is recorded. L. S. T.

Bellingerite, a new mineral from Chuquicamata, Chile. H. Berman and C. W. Wolfe (*Amer. Min.*, 1940, 25, 505—512).—Bellingerite, triclinic, $a:b:c = 0.9264:1:1.0149$, a 105° 06', β 96° 57', γ 92° 55', a_0 7.22, b_0 7.82, c_0 7.92 Å., V_0 427.78 Å.³, mol. wt. 1267.93, hardness 4, ρ 4.89 ± 0.01 , n_x 1.890, n_y 1.90, n_z 1.99, contains 3 $\text{Cu}(\text{IO}_3)_2 \cdot 2\text{H}_2\text{O}$ per unit cell, and occurs as green crystals in veinlets with leightonite and gypsum in massive quartz. It appears to be the latest mineral deposited. A chemical analysis [F. A. Gonyer] is recorded. L. S. T.

Cordierite granite from Terip Terip, Victoria. G. Baker (*Amer. Min.*, 1940, 25, 543—548).—Cordierite (I), much of it altered to muscovite, chlorite, and micaceous products, is abundant in the Terip Terip granite, of which the chief minerals are quartz (II) 29.9, orthoclase (III) 34.1, oligoclase 19.1, cordierite 6.8, biotite 6.5, and muscovite 3.6%. (I) apparently crystallised before (II) and (III). Other occurrences in Victoria, and the origin of (I), are discussed. L. S. T.

Uraninite and thucholite from Pied des Monts, Charlevoix Co., Quebec. H. S. Spence (*Amer. Min.*, 1940, 25, 711—

718).—The character and occurrence of these minerals are described. Practically all of the uraninite (I) carries considerable thucholite as external crusts of friable, powdery material and as filling a network of minute veinlets penetrating the entire mass of the (I). L. S. T.

Optical properties and chemical composition of magnesian orthopyroxenes. H. H. Hess and A. H. Phillips (*Amer. Min.*, 1940, 25, 560).—A correction (cf. A., 1940, I, 334). L. S. T.

Thermal decomposition of arsenopyrite. J. S. Lukesh (*Amer. Min.*, 1940, 25, 539–542).—The decomp. of arsenopyrite heated in vac. is detectable at $\sim 650^\circ$. Crystals heated for many hr. at higher temp. are separated into two components. Powder photographs show these components to be As and pyrrhotite, but the pyrrhotite crystals resemble troilite in being non-magnetic. L. S. T.

Linear thermal expansion and inversions of quartz. J. L. Rosenholtz and D. T. Smith (*Amer. Min.*, 1941, 26, 103–109).—Apparatus for measuring linear thermal expansion between 0° and 1000° and determining inversion points is described. Results for the expansion of Brazilian rock crystal perpendicular and parallel to the principal axis are given. The α - β inversion occurs at $573.1 \pm 0.5^\circ$. A second change, ascribed to the quartz-tridymite inversion, was observed at $872 \pm 1^\circ$ for sections perpendicular to the principal axis. This was observed on only one of four parallel sections; the remaining three showed a sudden acceleration in the rate of contraction at $830 \pm 2^\circ$. L. S. T.

Occurrence of willemite. F. H. Pough (*Amer. Min.*, 1941, 26, 92–102).—Willemite, Zn_2SiO_4 , is often considered to be characteristic of deposition under conditions of high temp., but by far the largest no. of occurrences, including seven new localities, indicate a formation through secondary alteration of ore minerals, often under arid climatic conditions. L. S. T.

Occurrence and origin of babingtonite and other minerals from Quabbin Aqueduct, Massachusetts. B. M. Shaub (*Amer. Min.*, 1941, 26, 121–129).—The vein minerals are described, and their paragenesis and origin discussed. L. S. T.

Pyrostilpnite from Randsburg, California. J. Murdoch (*Amer. Min.*, 1941, 26, 130–132).—Pyrostilpnite, Ag_3SbS_3 , occurs in small amount among the Ag minerals of the California Rand mine. L. S. T.

Molybdenite at Magnet Cove, Arkansas. V. G. Sleight (*Amer. Min.*, 1941, 26, 132–133).—The molybdenite is disseminated throughout grey, siliceous material, which is probably geyserite. L. S. T.

X-Ray methods of determination and investigation of lead stibnites. J. E. Hiller and W. Hofmann (*Z. Krist.*, 1939, 102, 143–144; cf. A., 1938, I, 288).—Reasons for the period of ~ 4 Å. in the b -parameters of Pb stibnites are indicated (cf. *Z. Krist.*, 1935, 92, 161). A. J. E. W.

Wurtzite-sphalerite transition of zinc sulphide. F. A. Kröger [with F. M. Jacobs] (*Z. Krist.*, 1939, 102, 136–137).—The velocity of transformation of the enantiotrophic forms (transition temp. $1020 \pm 5^\circ$) depends on the size of the crystals, as in metals (cf. Dehlinger, A., 1932, 454; Shōji, A., 1931, 788). A. J. E. W.

Falkmanite. J. E. Hiller (*Z. Krist.*, 1939, 102, 138–142).—Falkmanite (I) (a mineral from Mines Geraes and Pfaffenreuth, previously confused with jamesonite) is monoclinic, with a 24.93, b 8.10, c 14.51 Å., β $79^\circ 10'$ ($a:b:c = 3.077:1:1.791$); 10 mols. in unit cell; $\rho_{\text{obs.}}$ 6.2; $\rho_{\text{calc.}}$ 6.06. Reasons for retaining the formula $\text{Pb}_2\text{Sb}_2\text{S}_5$ are detailed. (I) is closely related to boulangerite (cf. A., 1938, I, 288). A. J. E. W.

Spessartite in pegmatite at Mount Antero, Colorado. R. M. Pearl (*Amer. Min.*, 1941, 26, 54).—Crystals of spessartite, growing on quartz, microcline, and muscovite, occur in cavities in dyke- and lens-shaped pegmatites in a post-cretaceous granite stock. L. S. T.

Relation between colour and chemical composition in the biotites. A. J. Hall (*Amer. Min.*, 1941, 26, 29–33).—Chemical analyses and colours of 56 biotites are tabulated. The colours of the common biotites appear to depend on the relative contents of Fe, MgO, and TiO_2 . Fe is responsible for the green colours, TiO_2 for the brown and red, whilst MgO

has a diluent or masking effect on the colour produced by TiO_2 . Colour gives little real indication of the composition of a biotite. L. S. T.

Relation between chemical composition and refractive index in the biotites. A. J. Hall (*Amer. Min.*, 1941, 26, 34–41).—The relation between chemical composition and n should be considered from the point of view of the substitution of the metal atoms in the structural formula. That the effect of Fe^{2+} , Fe^{3+} , Ti^{3+} , and, probably, of Ti^{4+} , Mn^{2+} , Zr^{4+} , Cr^{3+} , etc., must be taken into account is illustrated by plotting the vals. of total Fe against n for 59 biotites (analyses given). L. S. T.

Chemical composition of garnet associated with cordierite. R. E. Folinsbee (*Amer. Min.*, 1941, 26, 50–53).—Garnet, biotite, and cordierite are associated in thermally metamorphosed sediments only when the composition of the garnet lies within a restricted range of almandine 71–78, pyrope 12–25, spessartite 2, and grossularite 5%. This is of diagnostic val. for cordierite, which is often difficult to recognise. A chemical analysis of garnet from Great Slave Lake, Canada, is recorded. L. S. T.

Unit cell and space-group of vrbaitite, seligmannite, and samsonite. C. Frondel (*Amer. Min.*, 1941, 26, 25–28).—The Weissenberg equi-inclination method gives for vrbaitite from Allchar, a_0 13.35, b_0 23.32, c_0 11.23 Å. (all ± 0.05 Å.); space-group $Cmca$; cell content $\text{Ti}_{12}(\text{AsSb})_{63}\text{S}_{105}$, for samsonite (I) from Andreasberg, a_0 10.29, b_0 8.05, c_0 6.61 Å. (all ± 0.05 Å.); space-group $P2_1/n$; cell content $\text{Ag}_6\text{Mn}_2\text{Sb}_2\text{S}_{12}$, for seligmannite (II) from Bingham, a_0 8.04, b_0 8.66, c_0 7.56 Å. (all ± 0.05 Å.); space-group $Pnmm$; cell contents $\text{Cu}_4\text{Pb}_4\text{As}_4\text{S}_{12}$, $\rho_{\text{obs.}}$ for (I) and (II) are 5.51 and 5.38, respectively. X-Ray powder photographs of aikinite, CuPbBiS_3 , from Beregov differ markedly from those of (II) and bournonite, indicating that probably it is not a member of this group. L. S. T.

Colorado cerite. R. A. Hanson and D. W. Pearce (*Amer. Min.*, 1941, 26, 110–120).—Chemical analyses of cerite and its associated allanite from near Boulder, Colorado, are recorded. The Al_2O_3 content in the cerite is \gg that reported previously (A., 1940, I, 380). The formula is $2\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{K}_2\text{O} \cdot 2\text{SiO}_2$ (R = rare earths). The peculiar structural relations existing between the cerite, the purple fluorite enclosed in it, and the narrow black border of allanite that surrounds it are discussed. Combined spectrographical and chemical determinations of the individual rare earths in the cerite and allanite show that these minerals fit into their prescribed type in the Goldschmidt-Thomassen classification. L. S. T.

Crystallography of ulexite. J. Murdoch (*Amer. Min.*, 1940, 25, 754–762).—Cryst. ulexite (I) from the Suckow Borax Mine, California, has $a:b:c$ 0.6855:1:0.5191, a_0 8.71, b_0 12.72, c_0 6.69 Å., α $90^\circ 16'$, β $109^\circ 08'$, γ $105^\circ 07'$, $\rho_{\text{obs.}}$ 1.955, $\rho_{\text{calc.}}$ 2.001, hardness 2.5+, two mols. per unit cell; space-group C_2^2 — PI . Chemical analyses of (I) from this and other localities are compared. L. S. T.

Exsolution growths of zincite in manganosite and of manganosite in periclase. C. Frondel (*Amer. Min.*, 1940, 25, 534–538).—Manganosite (I) from Franklin, New Jersey, contains exsolved plates of zincite. Periclase from Långban and Nordmark, Sweden, contains exsolved octahedra of (I). The structural relations expressed in the orientations, and the solid solubility of Zn in MnO and of Mn in MgO, are discussed. L. S. T.

Clinobarrandite and the isodimorphic series, variscite-metavariscite. D. McConnell (*Amer. Min.*, 1940, 25, 719–725).—“Clinobarrandite” (I) is the name proposed for a new monoclinic mineral having the same composition as barrandite (V), $(\text{Al}, \text{Fe})\text{PO}_4 \cdot 2\text{H}_2\text{O}$. The probable space-group of metavariscite (II), (I), and phosphosiderite (III) is $P2_1/n$. A second locality for (II) is Candelaria, Nevada. The following vals. for a_0 , b_0 , c_0 , $\rho_{\text{calc.}}$, and $\rho_{\text{obs.}}$ are recorded: variscite (IV) 9.85, 9.55, 8.50 Å., 2.61, 2.5; strengite (VI) 10.05, 9.80, 8.65 Å., 2.89, 2.87; scorodite 10.30, 10.00, 8.90 Å., 3.32, 3.3; (II) 5.15, 9.45, 8.45 Å., 2.53, 2.54; and (III) 5.30, 9.80, 8.65 Å., 2.74, and 2.76. Powder diffraction photographs of (III), (II) + (IV), (V), (I) + (V), and (VI) are reproduced. L. S. T.

Mineral sulpho-salts. IV. Galenobismutite, or “lillinite.” L. G. Berry (*Amer. Min.*, 1940, 25, 726–734).—Galenobismutite (I) from Nordmark Mines, Sweden, is orthorhombic with a_0 11.72 ± 0.03 , b_0 14.52 ± 0.03 , c_0 4.07 ± 0.02 Å.,

$\rho_{\text{obs.}}$ 7.04, $\rho_{\text{calc.}}$ 7.18; space-group D_{2h}^{16} — $Pnam$ or C_{2v}^{27} — $Pna2$. The unit cell contains 4 $PbS_2 \cdot Bi_2S_3$. Etch reactions are: HNO_3 , violent effervescence, deep etching, and a yellow deposit left; HCl , slight brown stain; KCN , $FeCl_3$, KOH , $HgCl_2$, negative. (I) from Cariboo Gold Quartz Mine, British Columbia, and "lillianite" from Mt. Farrell, Tasmania, give X-ray patterns identical with that of the above material. "Lillianite" from Gladhammar is a mixture of (I) and galena. "Lillianite" is not a mineral species. X-Ray powder photographs and data are reproduced. L. S. T.

Classification of minerals of the type $A_3(XO_4)_2 \cdot nH_2O$. C. W. Wolfe (*Amer. Min.*, 1940, 25, 738—753, 787—809).—Evidence showing that the H_2O present in these minerals is H_2O of crystallisation and not zeolitic is presented, and the minerals of this type are classified into families on the basis of the no. of mols. of H_2O present, since minerals containing the same no. of H_2O mols. show definite similarities which are modified only slightly by the cations and anions present. New data are: (i) $A_3(XO_4)_2 \cdot 2H_2O$ family: collinsite (I), $Ca_2(Mg,Fe)(PO_4)_2 \cdot 2H_2O$, triclinic, a_0 5.70, b_0 6.72, c_0 5.38 Å., α 96° 48', β 107° 16', γ 104° 32', space-group C_1^1 — PI , $\rho_{\text{obs.}}$ 2.992, $\rho_{\text{calc.}}$ 3.04, hardness 3.5; fairfieldite, $Ca_2(Mn,Fe)(PO_4)_2 \cdot 2H_2O$, triclinic, a_0 5.77, b_0 6.56, c_0 5.47 Å., α 102° 05', β 108° 42', γ 90° 05', space-group C_1^1 — PI , $\rho_{\text{obs.}}$ 3.082, $\rho_{\text{calc.}}$ 3.09, hardness 3.5; roselite, $Ca_2(Co,Mg)(AsO_4)_2 \cdot 2H_2O$, monoclinic, a_0 5.60, b_0 12.80, c_0 5.60 Å., β 100° 45', space-group C_{2h}^2 — $P2_1/c$, $\rho_{\text{obs.}}$ 3.695, $\rho_{\text{calc.}}$ 3.645, hardness 3.5; brandtite, $Ca_2Mn(AsO_4)_2 \cdot 2H_2O$, monoclinic, a_0 5.65, b_0 12.80, c_0 5.65 Å., β 99° 30', space-group C_{2h}^2 — $P2_1/c$, $\rho_{\text{obs.}}$ 3.671, $\rho_{\text{calc.}}$ 3.700, hardness 3.5; (ii) $A_3(XO_4)_2 \cdot 3H_2O$ family: reddingite, $(Mn_{3/4}, Fe_{1/4})(PO_4)_2 \cdot 3H_2O$, orthorhombic, a_0 9.52, b_0 10.06, c_0 8.70 Å., space-group D_{2h}^{16} — $Pnma$, $\rho_{\text{obs.}}$ 3.22, $\rho_{\text{calc.}}$ 3.244, hardness 3—3.5; (iii) $A_3(XO_4)_2 \cdot 4H_2O$ family: parahopeite, $Zn_3(PO_4)_2 \cdot 4H_2O$, triclinic, a_0 5.755, b_0 7.535, c_0 5.292 Å., space-group C_1^1 — PI , α 93° 17', β 91° 55', γ 91° 10', $\rho_{\text{obs.}}$ 3.307, $\rho_{\text{calc.}}$ 3.304, hardness 3.75; anapaite (III), $Ca_2Fe(PO_4)_2 \cdot 4H_2O$, triclinic, a_0 6.41, b_0 6.88, c_0 5.86 Å., α 101° 34', β 104° 05', γ 71° 03', $\rho_{\text{obs.}}$ 2.812, $\rho_{\text{calc.}}$ 2.796, hardness 3.5; phosphophyllite, $Zn_2(Fe,Mn)(PO_4)_2 \cdot 4H_2O$, monoclinic, a_0 10.23, b_0 5.08, c_0 10.49 Å., β 120° 15', space-group C_{2h}^2 — $P2_1/c$, $\rho_{\text{obs.}}$ 3.130, $\rho_{\text{calc.}}$ 3.144, hardness 3.5; hopeite, $Zn_3(PO_4)_2 \cdot 4H_2O$, orthorhombic, a_0 10.64, b_0 18.32, c_0 5.03 Å., space-group D_{2h}^{16} — $Pnma$, $\rho_{\text{obs.}}$ 3.04, $\rho_{\text{calc.}}$ 3.08, hardness 2.5—3; $A_3(XO_4)_2 \cdot 8H_2O$ family: symplectite, $Fe_3(AsO_4)_2 \cdot 8H_2O$, triclinic, a_0 7.85, b_0 9.39, c_0 4.71 Å., α 99° 55', β 97° 22', γ 105° 57', space-group C_1^1 — PI , $\rho_{\text{obs.}}$ 3.012, $\rho_{\text{calc.}}$ 3.022; köttigite, $Zn_3(AsO_4)_2 \cdot 8H_2O$, monoclinic, a_0 10.11, b_0 13.31, c_0 4.70 Å., β 103° 60', space-group C_{2h}^2 — $C2/m$, $\rho_{\text{obs.}}$ 3.33, $\rho_{\text{calc.}}$ 3.32, hardness 2.5—3, n_z 1.622, n_y 1.638, n_x 1.671; vivianite, annabergite, erythrite, bobierrite, and hoernesite also belong to this family. The no. of mols. per unit cell of the triclinic species is one, of the monoclinic, two, and of the orthorhombic, four. New chemical analyses [F. A. Gonyer] of (I) and messilite (II) are recorded. (II), a_0 6.59, b_0 6.81, c_0 5.76 Å., is a mixture of (I) and (III), and is not a mineral species. Trichalcite, $Cu_3(AsO_4)_2 \cdot 5H_2O$ (?), a_0 10.34, b_0 26.9, and c_0 5.57 Å., probably does not belong to the type. The investigation shows that hydrated minerals should be classified with their anhyd. analogues in the same type, and that the properties of the minerals of any one type will vary in a simple manner with their H_2O contents. L. S. T.

Geology of the iron ore field of South Cumberland and Furness. K. C. Dunham and W. C. C. Rose (*Dept. Sci. Ind. Res., Wartime Pamphlet No. 16*).—Stratigraphy, glacial drift, and structure of the area are described. The Fe ore-bodies include flats, sops, and veins, and consist mainly of hæmatite of the hard, "blue," massive type. The kidney form occurs frequently in cavities. Representative percentages are Fe (wet ore) 45—55, SiO_2 1—20, $CaCO_3$ 0.5—10, P 0.015, and S 0.010. CaO in sop is generally < in flat and vein ores, and P shows an increase in ore-bodies adjacent to shales or sandstone. Complete analyses of hæmatite ores from six localities, and numerous partial analyses of Fe ores from many other localities, are recorded. Mn is seldom entirely absent, and in places sufficient Mn minerals are present to make ore-bodies workable for the Mn content. Structural and stratigraphical control of ore bodies are discussed. There is no evidence for a deep-seated origin of the deposits. L. S. T.

Pentlandite from the copper-nickel deposits of Monche-Tundra. I. N. Tschirkov (*Compt. rend. Acad. Sci. U.R.S.S.*,

1940, 29, 601—603).—Within the vein deposits of the Cu-Ni ores of Monche-Tundra there occur two generations of pentlandite. W. R. A.

Marie Byrd land rocks. D. Stewart, jun. (*Amer. Min.*, 1941, 26, 42—47).—The mineralogical compositions of 44 metamorphic rocks are tabulated. Comparisons between these and other rocks from Antarctic lands are made.

L. S. T.
Garabal Hill-Glen Fyne igneous complex. S. R. Nockolds (*Quart. J. Geol. Soc.*, 1940, 96, 451—511).—The petrography of this complex, which consists of a series of intrusions from ultrabasic to acid, is described. Chemical analyses are recorded, and petrogenesis is discussed. Crystallisation-differentiation, coupled with contamination for certain types, explains the rocks observed in the complex. The parent magma is probably a pyroxene-mica-diorite, and details of the differentiation process are worked out. L. S. T.

Alteration of detrital minerals in the Mesozoic rocks of Yorkshire. F. Smithson (*Geol. Mag.*, 1941, 78, 97—112).—The occurrence of garnet, staurolite, monazite, apatite, and TiO_2 minerals in a belt coinciding with the Cleveland axis is described. Mineralogical changes in this belt have been active after the deposits were laid down. L. S. T.

Classification of volcanoids. G. A. Maximovitsch (*Compt. rend. Acad. Sci. U.R.S.S.*, 1940, 29, 596—600).—Volcanoids are classified thus: thermo- (pyrogenous, technogenous); eu- (thalassogenous, potamogenous, naphthogenous, tectogenous); cryo- (helogenous, limnogenous); and seismo-volcanoids (seismogenous). W. R. A.

Petrography of two Iowa loess materials. F. L. Cuthbert (*Amer. Min.*, 1940, 25, 519—527).—Mechanical and chemical analyses, X-ray data, and base-exchange determinations are recorded, and discussed in relation to the suitability of these materials for highway construction. L. S. T.

Colloidal clay in solonchak and solonetz soils in Manchuria. R. Kawashima and M. Nagata (*J. Agric. Chem. Soc. Japan*, 1941, 17, 394—395).—The colloidal clay < 1 μ . in diameter is separated by sedimentation. The ratios $SiO_2 : Al_2O_3$ and $SiO_2 : R_2O_3$ are 4.15—4.50 and 3.11—3.30, respectively. The base-exchange capacity, determined by the NH_4OAc method, varies from 40.10 to 64.35 m-equiv. This high val. is due to contaminating humic substances. J. N. A.

Comparative petrology of British and American coals of carboniferous age.—See B., 1941, I, 324.

Thermodynamics and coal formation. W. Fuchs (*Amer. Inst. Min. Met. Eng.*, 1941, *Tech. Publ.* 1333, 12 pp.; *Min. Tech.*, 1941, 5, No. 3; cf. B., 1941, I, 164).—Geological facts concerning the evolution of coal are summarised. The free energy changes associated with hydrolytic, oxidation, reduction, and ring-closure reactions which may take part in the initial stages of the evolution are discussed, and it is considered that these changes give rise to the formation of lignins, resins, waxes, etc. Under aerobic conditions the action of micro-organisms will be inhibited owing to deficiency of N supply, and the products will develop OH and CO_2H groups, such as are found in brown coals and lignites. The probable temp. and pressure conditions occurring during coal development are insufficient to account for the formation of bituminous coal and anthracite, and it is suggested that under anaerobic conditions the initial changes are succeeded by loss of O to a degree determined by the prevailing redox potential. The relation of the theory to other theories of coal evolution is discussed. J. W. S.

Age determination of carboniferous basic rocks of Shropshire and Colonsay. I. W. D. Urry. II. A. Holmes (*Geol. Mag.*, 1941, 78, 45—48).—I. The application of the He method to the determination of the age of the monchiquite dykes of Colonsay, and for purposes of comparison, to two Carboniferous basic rocks from Shropshire, is described.

II. The geological relations and petrology of these rocks are described and discussed. Chemical analyses are recorded. The Colonsay monchiquites are of late Carboniferous or more probably of Permian age. L. S. T.

Geology of British Oilfields. II. Geology of the oilfields and some prospective oil areas in Canada. G. S. Hume (*Geol. Mag.*, 1941, 78, 1—36).—Descriptive. L. S. T.

BRITISH CHEMICAL AND PHYSIOLOGICAL ABSTRACTS

A., I.—General, Physical, and Inorganic Chemistry

OCTOBER, 1941.

I.—SUB-ATOMICS.

Properties of the witch of Agnesi. Application to fitting the shapes of spectral lines. R. C. Spencer (*J. Opt. Soc. Amer.*, 1940, 30, 415—419).—Mathematical. The properties of the curve $y = ha^2/(a^2 + x^2)$, which approximates to the energy distribution in spectral and particularly X-ray lines, are described. O. D. S.

Electrical discharges from pointed conductors. J. Zeleny (*J. Franklin Inst.*, 1941, 232, 23—37).—A review. The general properties of discharges from points are considered. The behaviour of discharges near the breakdown potential is discussed, the differences between negative and positive discharges under these conditions being pointed out. The action of point Geiger counters is discussed. The appearances of positive and negative discharges from points are quite different. Positive discharge currents in air and H_2 , but not in N_2 , show irregular high-frequency variations of considerable magnitude. In the initial stages of positive currents from points, the discharges consist of isolated bursts, the current in each burst having apparently the same type of fluctuation as is observed at higher voltages when the current appears continuous. This has been re-examined, and the discontinuity in the current-voltage curve near the onset of positive discharges is attributed to the galvanometer formerly used. The effect of artificial ionising sources on point discharges is considered. When a strong radioactive source was brought up to a positively charged point a considerable current could be made to flow before the min. starting potential was reached; the current disappeared altogether when the source was removed. Above the min. potential the current continued to flow after removal of the source, but fell to the val. it would have had in the absence of the source. The magnitude of the current is, therefore, not controlled solely by space-charge effects. For a negatively charged point, the saturation current due to the production of ions by the radioactive source remained const. as the potential of the point was raised, until at a certain val. it increased by a factor of 100 or more. The voltage at which this occurred depended on the no. of ions introduced. The difference in the effect for negative and positive points is explained. A. J. M.

Mechanism of electrical discharges in gases of low pressure. M. J. Druyvesteyn and F. M. Penning (*Rev. Mod. Physics*, 1940, 12, 87—174).—A summary. W. R. A.

Ions in gases. J. Zeleny (*Science*, 1941, 93, 167—172).—An address. L. S. T.

Discharge of the particles of an aerosol in a dipolar ionic atmosphere. N. Tunitzki, V. Sarinski, and J. Petrijanov (*Acta Physicochim. U.R.S.S.*, 1940, 13, 327—346).—It is shown theoretically that the discharge follows the law $z_t = z_0 e^{-\rho t}$, where z_0 and z_t are the initial charge and charge after time t , respectively, and ρ is a const., \propto the ionic concn. but independent of the radius of the particle. The law has been confirmed experimentally and the observed val. of ρ has been found to be of the same order of magnitude as the theoretical val. J. W. S.

Ring discharge. C. G. Smith (*Physical Rev.*, 1941, [ii], 59, 997—1004).—An c.m.f. of 890 cycles per sec. was used to energise a ring discharge in Hg vapour at $\sim 2 \times 10^{-4}$ mm. pressure. Probe experiments show a true electronic temp. of $\sim 300,000^\circ K$. at the peak of the wave of energisation. Only 13% of the atoms were ionised at the max. of the cycle of ionisation. Strong lines of Hg I, II, III, with faint lines of Hg IV, were observed. The forbidden line $1^1S_0-2^3P_2$ 357

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was definitely, and the forbidden line $1^1S_0-2^3P_2$, possibly, observed at the highest electronic temp. only. A probable rate of ion production in an electronic atm. of given density and temp. is calc. To explain the observed limitation of degree of ionisation, a hypothesis involving recombination of ion and electron with conservation of electrical energy is given. N. M. B.

Resistivity of interstellar space. F. L. Mohler (*Physical Rev.*, 1941, [ii], 59, 1043).—Under the conditions postulated by Evans (cf. A., 1941, I, 95) the collision radius for a collision of an electron with a positive ion is 50×10^{-8} cm. so that the scattering by neutral atoms is entirely negligible. The mean free path is $\sim 5 \times 10^{12}$ and not 10^{15} cm. The resistivity calc. from the equation for an ionised gas is 0.2 ohm-cm. N. M. B.

Time lags in Geiger-Müller counter discharges. C. G. Montgomery and D. D. Montgomery (*Physical Rev.*, 1941, [ii], 59, 1045; cf. A., 1940, I, 594).—Observed time lags were attributed to the capture of the electrons of the primary ion pairs, forming negative mol. ions which moved relatively slowly into the region of the counter wire. Experiments are described supporting this explanation and measuring the capture probabilities. The estimated capture cross-section of an electron by an O_2 mol. is $\sim 10^{-18}$ sq. cm. (cf. Rose, A., 1941, I, 306). N. M. B.

Acceleration of electrons by magnetic induction. D. W. Kerst (*Physical Rev.*, 1941, [ii], 60, 47—53).—Apparatus with which electrons were accelerated to 2.3 Me.v. energy by means of the electric field accompanying a changing magnetic field is described. Stable circular orbits are formed in a magnetic field, and the changing flux within the orbits accelerates the electrons. As the magnetic field reaches its peak val., saturation of the Fe supplying flux through the orbit causes the electrons to spiral inwards towards a W target. The X-ray intensity produced is approx. that of the γ -rays from 1 g. of Ra, and, because of the tendency of the X-rays to proceed in the direction of the electrons, a pronounced beam is formed. N. M. B.

Electronic orbits in the induction accelerator. D. W. Kerst and R. Serber (*Physical Rev.*, 1941, [ii], 60, 53—58).—Mathematical. The principles of operation of the electron induction accelerator (cf. preceding abstract), and an analysis of the electron orbits with reference to the design of the accelerator, are given. N. M. B.

Mechanical model for the motion of electrons in a magnetic field. A. Rose (*J. Appl. Physics*, 1940, 11, 711—717).—A gyroscope mounted with its axis in the direction of the magnetic field can be used to simulate the path of an electron in a magnetic field. Some photographs of particular cases are given. A. J. M.

Heavy-carbon production by thermal diffusion. W. W. Watson (*Science*, 1941, 93, 473—474).—Results achieved in the concn. of ^{13}C in CH_4 by a multi-stage thermal diffusion apparatus of the type described previously (A., 1941, I, 68) are recorded. The apparatus is suitable for obtaining a concn. of ^{13}C sufficient for tracer-atom work in biological experiments. L. S. T.

Dependence of the secondary electronic emission produced by γ -radiation on the direction of the radiation. C. W. Wilson (*Proc. Physical Soc.*, 1941, 53, 613—623).—Experiments described show that the electronic emission from a sheet of material, due to γ -radiation, depends on the direction of the radiation with respect to the sheet. In certain directions,

358

the emission from the sheet is equiv. to that from a sheet of "air-wall" material (graphite). An approx. explanation is given. An examination of the electronic emission from bone irradiated with γ -rays indicates how the energy absorption per röntgen of γ -rays may change at boundaries between bone and soft tissues. N. M. B.

Passage of neutrons through ferromagnets. O. Halpern and T. Holstein (*Physical Rev.*, 1941, [ii], 59, 960—981).—Mathematical. General equations are set up for the behaviour of the neutron spin in different types of magnetic fields which correspond approx. with various stages of magnetisation in ferromagnets, and general results for the depolarisation of an originally polarised beam are obtained. The domain theory of structure is reviewed, and the possibilities of investigating this structure, with reference to single crystals, macroscopically unmagnetised polycrystals, and polycrystals near magnetic saturation, are examined. Formulae for the change of intensity and polarisation of a neutron beam traversing a saturated or quasi-saturated ferromagnetic medium are derived, and form the basis for a modified theory of neutron polarisation experiments. N. M. B.

Passage of neutrons through crystals and polycrystals. O. Halpern, M. Hamermesh, and M. H. Johnson (*Physical Rev.*, 1941, [ii], 59, 981—996; cf. preceding abstract).—Mathematical. The influence of crystal structure on the scattering and polarisation of neutrons is investigated. Scattering formulae are developed which lead to a quant. interpretation of experimental deviations from additivity of nuclear cross-sections. The Larmor precession of the spin of a neutron passing through a magnetised medium and the differentiation between the action of the vectors " B " and " H " are explained as a simple dispersion phenomenon. The formulae permit quant. determination of the transmission and polarisation of neutron beams passing through ferromagnetics. Uncertainties in the evaluation of experiments are discussed. N. M. B.

New radioactive series. (A) W. Wahl. (B) A. C. Lane (*Science*, 1941, 93, 16—17, 17).—(A) Mass spectrograms of geologically-old minerals of the tantalum-Nb group, which contain also some U, Th, and rare-earth metals, show a mass-line 237. This line, which has never before been obtained, must be a member of a new radioactive series of elements. The element may be the parent of the new series, or it may originate from an unknown U isotope. The stable end-product of the new series should be ^{205}Pb or ^{209}Pb . Some of the spectra containing the 237 line show a weak line at 205. (B) A comment on the above. L. S. T.

Scattering of slow neutrons by molecular gases. R. G. Sachs and E. Teller (*Physical Rev.*, 1941, [ii], 60, 18—27).—Mathematical. The cross-section for the scattering of slow neutrons by protons is four times as great for protons strongly bound to an infinite mass as for free protons initially at rest. A simple generalisation of this factor 4 is given for the scattering of neutrons by mol. gases if the neutron energy is \gg the quanta of mol. vibration. In this case the proton may be replaced by a freely moving hypothetical mass point, the mass of which is a tensor depending on the mass and structure of the mol. On this basis the total cross-section for the scattering of slow neutrons by H_2 and by CH_4 , NH_3 , and H_2O at low temp. is calc. as a function of the ratio of the neutron energy to the thermal energy of the scattering gas. The possibility of applying the theory to a determination of the neutron-proton scattering cross-section is discussed. N. M. B.

β -Ray energy of ^3H . S. C. Brown (*Physical Rev.*, 1941, [ii], 59, 954—956).—Using as detector a screen-wall Geiger-Müller counter with He at atm. pressure, the max. range of the ^3H β -rays in He was determined as 13 ± 1 mm., corresponding with a max. energy of 9.5 ± 2.0 ke.v. N. M. B.

Production of radioactive hydrogen by neutron bombardment of boron and nitrogen. R. Cornog and W. F. Libby (*Physical Rev.*, 1941, [ii], 59, 1046).—Saturated solutions containing excess of H_3BO_3 or NH_4NO_3 were bombarded for several thousand $\mu\text{a.}$ -hr. by fast neutrons produced by the ^9Be (d, n) ^{10}B reaction with 16.5-Me.v. deuterons. The H_2O , as vapour in a Geiger-Müller counter, showed an activity of $\sim 10^4$ counts per mole per sec. Possible reactions are discussed. The estimated fast neutron cross-section for the production of ^3H is 10^{-24} sq. cm. N. M. B.

Angular distribution of α -particles produced in the ^7Li -proton reaction. C. L. Critchfield and E. Teller (*Physical Rev.*, 1941, [ii], 60, 10—17; cf. Young, A., 1940, I, 426).—Mathematical. In a discussion of the reaction $^7\text{Li} + ^1\text{H} \rightarrow ^2\text{He}$ it is assumed that the ^7Li nucleus is odd, that the incident proton is in a P state, and that a broad (angular momentum 0) and a sharp (angular momentum $2\hbar$) nuclear resonance level participate in the reaction. Results are in qual. agreement with the observed dependence on energy of the reaction yield and of the angular distribution. N. M. B.

Scattering of 1—3-Me.v. protons by helium. N. P. Heydenburg and N. F. Ramsey (*Physical Rev.*, 1941, [ii], 60, 42—46).—An examination for the existence of resonance scattering analogous to the neutron-He resonance found for 1-Me.v. neutrons by Staub (cf. A., 1939, I, 171) is reported. If n - n and p - p nuclear forces are equal, such a resonance should occur in p -He scattering for protons of ~ 2 Me.v. The no. of protons scattered through 140° , observed as a function of their energy, passed through a max. at 2 Me.v., but the sharpness and height of the max. were several times less than for the n -He resonance. A qual. justification is given. Data for angular distribution of scattered protons for 30 — 140° scattering angles and 1—3 Me.v. proton energies are plotted. N. M. B.

New type of disintegration produced by deuterons. R. S. Krishnan and T. E. Banks (*Proc. Camb. Phil. Soc.*, 1941, 37, 317—323).— ^{62}Cu , ^{106}Ag , and ^{120}Sb are formed by the deuteron bombardment of Cu, Ag, and Sb respectively. The energy-yield curves have been determined and indicate that the process involved is ^2H , ^3H , ^4He , probably occurring through the formation of a "compound nucleus" of the Bohr type. The cross-sections for the formation of ^{106}Ag and ^{108}Ag by 9-Me.v. deuterons are 2.5×10^{-29} and 1×10^{-25} cm 2 , respectively. O. D. S.

Production of characteristic X-rays by deuteron bombardment. J. M. Cork (*Physical Rev.*, 1941, [ii], 59, 957—959). It is shown by a photographic method that for 10-Me.v. deuterons, characteristic K radiation is emitted from targets of at. no. ≥ 38 . Because of absorption, the intensity has a max. for elements of at. no. ~ 28 . L radiation is observed for heavier elements with a max. at at. no. ~ 64 . For a Cu target the yield of X-rays is observed as a function of exciting energy. Results are compared with theory (cf. Henneberg, A., 1933, 881). N. M. B.

Mechanism of deuteron-induced fission. N. Bohr (*Physical Rev.*, 1941, [ii], 59, 1042).—Available data and theoretical considerations are discussed in relation to the discrimination of the two types of processes in deuteron-induced nuclear transformations. N. M. B.

Fission cross-section in uranium and thorium for deuteron impact. J. C. Jacobsen and N. O. Lassen (*Physical Rev.*, 1941, [ii], 59, 1043; cf. A., 1941, I, 144).—The fission cross-section in U at 9 Me.v. deuteron energy, corr. by a calibrating process, is $2.2 \pm 1 \times 10^{-29}$ sq. cm. Hence the U-Th cross-section ratio 0.7 gives $1.5 \pm 0.7 \times 10^{-29}$ sq. cm. for the corresponding Th fission cross-section. N. M. B.

Resonance energy of the thorium capture process. L. Meitner (*Physical Rev.*, 1941, [ii], 60, 58—60; cf. A., 1941, I, 187).—The resonance energy was determined by measuring the absorption in Th for various neutron resonance groups picked out by suitable detectors (Au, In, Rh). Neutron groups having absorption coeffs. with ratio which is not inversely \propto the ratio of the respective velocities indicate a resonance group of the Th capture process within the energy range considered. Results show that for resonance energy $E = 0.9$ e.v. the experimental capture cross-section is \gg , and for $E = 3.5$ e.v. somewhat $<$, that calc. on the $1/v$ law. It is concluded that the Th resonance level is between 0.2 e.v. (cut-off energy of Cd) and 3.5 e.v., and probably at ~ 2 e.v. N. M. B.

Nuclear particles in cosmic radiation. S. A. Korff (*Physical Rev.*, 1941, [ii], 59, 949—954; cf. A., 1941, I, 315).—Balloon-flight experiments with proportional counters show that α -particle counts due to slow-neutron-induced B disintegrations may account for \sim one third of the discharges with BF_3 counters. The estimated flux of highly ionising particles, mostly protons, is $\sim 10^{-3}$ per sq. cm. per sec. The calc. rate of production of protons (about the same as that of neutrons)

is $\sim 5 \times 10^{-2}$ per g. per sec. at 2 m. H_2O equiv. below the top of the atm. Results indicate that protons and neutrons are produced about equally by a process connected with the soft component of the radiation.

N. M. B.

Are there spin one mesotrons? H. Snyder (*Physical Rev.*, 1941, [ii], 59, 1043; cf. Christy, A., 1941, I, 235).—If mesotrons are responsible for nuclear forces, and if they do not have spin $\frac{1}{2}$, then the known spin dependence of nuclear forces demands that, in addition to mesotrons of spin 0, there must be particles of spin 1. There is experimental evidence that mesotrons of spin 0 and 1 are produced. They must be highly absorbable, and a disintegration lifetime of $\sim 10^{-8}$ sec. would not contradict cosmic-ray evidence.

N. M. B.

Secondary slow mesotrons. V. I. Veksler and N. A. Dobrotin (*Physical Rev.*, 1941, [ii], 59, 1044—1045; cf. A., 1941, I, 91).—Measurements with arrangements of counters at 4250 m. confirm the secondary nature of the slow particles (mesotrons) observed (cf. A., 1941, I, 288). Available data are reviewed (cf. Rossi, *ibid.*, 145).

N. M. B.

Extensive cosmic-ray showers and the energy distribution of primary cosmic rays. N. Hilberry (*Physical Rev.*, 1941, [ii], 60, 1—9).—An experimental determination of the variation of the no. of extensive showers per unit time from sea level to 4300 m. is described. The no. of showers expected, calc. on the cascade theory with assumption of various power-law energy distributions for the primary cosmic rays, accords with observation at high altitudes for suitable choice of parameters; at low altitudes the observed excess is what would be expected from a mesotron component in the extensive showers. The choice of parameters giving good agreement with the extensive shower data will also described cosmic-ray observations at much lower energies, and this strongly supports the hypothesis of a single type of primary cosmic-ray particle. The consequences of choosing the proton as this primary particle are discussed.

N. M. B.

Sun's magnetic field and the diurnal and seasonal variations in cosmic-ray intensity. L. Janossy and P. Lockett (*Proc. Roy. Soc.*, 1941, A, 178, 52—60).—The diurnal and seasonal variations in the vertical cosmic-ray intensity due to a solar magnetic dipole are calc. for latitudes 0° and 45° . The diurnal variation at latitude 45° agrees with the existence of a solar dipole of moment 1.1×10^{34} gauss cm^3 , a val. consistent with other evidence. The diurnal variation at the equator cannot be explained by a solar magnetic dipole field. The seasonal variation inferred from the same val. of the dipole moment agrees with observation but shows a phase discrepancy of 2 months.

G. D. P.

Influence of radiation damping on the scattering of light and mesons by free particles. I. W. Heitler (*Proc. Camb. Phil. Soc.*, 1941, 37, 291—300).—Mathematical. Quantum-theory equations for the effect of radiation damping on the scattering of light and mesons are developed. The effect is important for mesons at high energies but is small at low energies.

O. D. S.

Quantum theory of radiation damping. A. H. Wilson (*Proc. Camb. Phil. Soc.*, 1941, 37, 301—316).—A method of calculating the effect of damping on the collision cross-sections for problems involving free electrons and mesons is developed. The final equations are the same as those derived by Heitler (preceding abstract).

O. D. S.

Invariant forms of interaction between nuclear particles. L. Eisenbud and E. P. Wigner (*Proc. Nat. Acad. Sci.*, 1941, 27, 281—289).—It is shown that it is reasonable to expect a wave-equation for heavy particles alone. The possible types of interaction between nuclear particles are investigated assuming the existence of a Hamiltonian for such particles. A non-relativistic approximation is used, and the only interactions considered are those which either do not contain the velocities (or momenta) of the particles, or contain them only to the first power. There are 18 invariant types of interaction between pairs of particles, which are linear in momenta.

A. J. M.

Nuclear radii. R. D. Present (*Physical Rev.*, 1941, [ii], 60, 28—31).—Mathematical. Corrections to the nuclear radius and particle density arising from the neutron excess $N - Z$, from the electrostatic repulsion of the protons, and from the surface tension forces, are calc. on the basis of the statistical model. The density throughout the interior of the heaviest

nuclei is found to be $\sim 30\%$ $<$ in medium light nuclei ($A \sim 50$). The trend of $r_0 = R/A^{1/3}$ from the lightest to the heaviest elements is discussed and compared with experiment.

N. M. B.

Particles with half-integral spin. W. Rarita and J. Schwinger (*Physical Rev.*, 1941, [ii], 60, 61).—Mathematical. An alternative formulation of the theory of Fierz and Pauli (cf. *Proc. Roy. Soc.*, 1939, A, 173, 211) on half-integral spins, avoiding the complicated spinor formalism.

N. M. B.

β -Decay with neutrino of spin $\frac{1}{2}$. S. Kusaka (*Physical Rev.*, 1941, [ii], 60, 61—62; cf. preceding abstract).—Mathematical. An investigation of distribution laws, energy-lifetime relations, and selection rules for β -decay with a neutrino of spin $\frac{1}{2}$ shows that for any coupling involving the neutrino wave function or its first derivative the spectrum distribution is predominantly of the Konopinski-Uhlenbeck type and the energy-lifetime relation for high energy is given by the seventh-power law. For neutrinos of non-zero mass, the Fermi and the Gamow-Teller selection rules are possible; for neutrinos of zero mass only the latter is permitted.

N. M. B.

II.—MOLECULAR STRUCTURE.

Flame spectrum of carbon monoxide. II. Application to "afterburning." A. G. Gaydon (*Proc. Roy. Soc.*, 1941, A, 178, 61—73; cf. A., 1941, I, 97).—The order of magnitude of the radiative lifetime of the vibrationally activated CO_2 mols. formed in the combustion of CO is derived. The results are in agreement with the experimental evidence concerning the effect of moisture and other catalysts on the infra-red emission of the flame. The lifetime is calc. to be about a few tenths of a sec., but dissociation and recombination processes may lengthen this time. The vibrationally active mols. of CO_2 are regarded as essentially normal mols. in which the vibrational energy has not had time to reach equipartition with the energy in other degrees of freedom. Investigation of the absorption spectrum of a long column of burning gas showed strong absorption due to hot O_2 , this being particularly marked when the gases are dry.

G. D. P.

New comet-tail band. R. K. Asundi (*Current Sci.*, 1940, 9, 503—504).—The masking by H_2 of comet-tail bands of CO^+ , produced in a discharge tube containing He and a trace of C, and simultaneous production of triplet C bands of CO can be controlled by suitable use of a Pd tube. Spectrograms of the triplet C bands in the far-red region show a relatively intense band degraded to longer $\lambda\lambda$ and possessing four heads like the comet-tail bands. This is the $3 \rightarrow 3$ band of the comet-tail system, and $\nu\nu$ agree satisfactorily with calc. vals. for the second and fourth heads. The position given by Herzberg (A., 1929, 489) for the system-origin is confirmed.

W. R. A.

Ultra-violet band spectrum of HgBr. M. G. Sastry (*Current Sci.*, 1941, 10, 197; cf. A., 1941, I, 291).—Wieland's class II band system at 2650—2900 \AA . has been re-examined, and is now ascribed to HgBr. A vibrational analysis gives the following consts. for the $^{202}\text{Hg}^{81}\text{Br}$ heads: ω_e 459.0, ω_e'' 372.3, $x_e''\omega_e''$ 3.6, $x_e'''\omega_e'''$ 3.8, ν_e (mol.) 34,537.8 cm^{-1} , ν (at.) 4.92, D' 1.81, D'' 1.15 ν . The quantum no. assignment is confirmed by observations on the $^{202}\text{Hg}^{79}\text{Br}$ bands. The system is probably due to a $^2\Sigma \rightarrow ^2\Sigma$ transition, with negligible spin doubling; the dissociation products in the two electronic states are $\text{Hg}(^1S) + \text{Br}(^2P)$ and $\text{Hg}(^3P) + \text{Br}(^2P)$.

A. J. E. W.

Atmospheric absorption and emission in the infra-red. J. Strong (*J. Franklin Inst.*, 1941, 232, 1—22).—By plotting intensity of radiation against the square root of the no. of air masses, or square root of the amount of H_2O vapour, in the line of sight, a straight line is obtained. By plotting atm. absorption data by this method, as well as by Langley's method (plotting log of radiation intensity against secant of the zenith distance of the sun), it is possible to decide whether the absorption is due to a continuous spectrum or to a band spectrum, since the former gives a linear graph by Langley's method, but not by the new one, and the latter gives a linear graph by the new method.

A. J. M.

Transmission of infra-red light by fog. J. A. Sanderson (*J. Opt. Soc. Amer.*, 1940, 10, 405—409; cf. Hulburt, *Physics*, 1934, 5, 101).—The transmission of clean natural fogs and of a thick snowstorm has been measured at $\lambda\lambda$ 1—12 μ . The

transmission curves, when corr. for the transmission of the clear atm. of approx. the same humidity (measurement taken directly after lifting of the fog), are flat and show no position of max. transmission in this λ region. O. D. S.

Infra-red spectra of polyatomic molecules. II. D. M. Dennison (*Rev. Mod. Physics*, 1940, 12, 175—214).—The theoretical treatment is briefly reviewed. Ascertained data are collected and discussed for CO_2 , H_2O vapour, NH_3 , Me halides, and CH_4 . W. R. A.

Ultra-violet absorption spectra of nitrogenous heterocyclic compounds. III. Effect of p_{H} and irradiation on the spectrum of 2-chloro-6-aminopyrimidine. (Miss) M. M. Stimson and J. R. Loofbrouwer (*J. Amer. Chem. Soc.*, 1941, 63, 1827—1829).—Two bands, possibly due to dissimilar chromophores, occur between 2200 and 2900 Å. The $>\text{C}=\text{N}$ —absorption shifts to longer λ as p_{H} rises from 3 to 7, and at higher p_{H} falls off, whilst the extinction of $>\text{C}=\text{N}$ —absorption increases from p_{H} 3 to 10. No apparent decomp. results from irradiation for 4 hr. W. R. A.

Absorption spectra of the phenylpyridines and pyridyl-diphenyls. A. E. Gillam, D. H. Hey, and A. Lambert (*J.C.S.*, 1941, 364—367).—The absorption spectra, between 2200 and 3100 Å., of 2-, 3-, and 4-phenylpyridine in EtOH solution, and of 2:2'- and 4:4'-dipyridyl, 3-2', 3-3', and 3-4', 4-2', 4-3', and 4-4'-pyridyldiphenyl in hexane solution have been measured and are represented graphically. The similarity of these spectra with those of di- and ter-phenyl (A., 1939, I, 449) indicates that the bond linking a $\text{C}_6\text{H}_5\text{N}$ to a C_6H_5 nucleus is similar in its resonance characteristics to that between two C_6H_5 nuclei. O. D. S.

Ultra-violet absorption spectrum of papain.—See A., 1941, III, 796.

Sensitized fluorescence (chemifluorescence) of benzene. H. A. Gordon (*Acta Physicochim. U.R.S.S.*, 1940, 13, 393—398).—When previously irradiated 1% glycine solution is evaporated to dryness and the residue shaken with H_2O and C_6H_6 , the fluorescence bands of C_6H_6 in the region 2500—3000 Å. are emitted, together with a band in the region 2420—2460 Å. There is a definite induction period for the fluorescence, which is independent of the concn. of irradiated glycine or of C_6H_6 but varies from 3 min. at 3° to 45 sec. at 40°. J. W. S.

Fluorescence of coumarin derivatives.—See A., 1941, II, 301.

Chemiluminescence of luminol catalysed by iron complex salts of chlorophyll derivatives.—See A., 1941, II, 271.

Optical methods for study of molecular structure: Raman spectra method. G. M. Murphy (*J. Opt. Soc. Amer.*, 1940, 10, 396—404).—A review. The methods of investigation of mol. structure by the Raman spectra, and results for simple gases, are discussed. O. D. S.

Optical sensitisation and photovoltaic effect of dyes. B. S. V. R. Rao (*Current Sci.*, 1941, 10, 198—199).—With erythrosin, chrysoidin, methylene-blue, and Me- and mala-chite-green the spectral regions for max. sensitisation and max. photo-potential correspond closely, and lie at slightly higher λ than the absorption max. The photovoltaic and sensitisation effects are probably secondary phenomena arising from impact of dye mols., activated by light absorption, with the electrode or sensitised emulsion. Sensitisation and desensitisation are probably a single phenomenon, the sensitiser acting on one or both of two opposed processes. A. J. E. W.

Electrical conduction and related phenomena in solid dielectrics. M. F. Manning and M. E. Bell (*Rev. Mod. Physics*, 1940, 12, 215—256).—A review in which are treated experimental methods, the methods for distinguishing between electronic and ionic conduction, ionic conductivity, dielectrics in alternating fields, lattice defects, semi-conductors, colour centres and photoconductivity, breakdown, and quantum-mechanical ideas of conduction. W. R. A.

Dielectric properties of the rutile form of TiO_2 . L. J. Berberich and M. E. Bell (*J. Appl. Physics*, 1940, 11, 681—692).—The dielectric const. (ϵ) and power factor at 60—10° cycles and 30—125° have been measured for three specimens of rutile prepared by compressing powdered material with and without ceramic admixture and firing at 1330—1675°.

ϵ is approx. const. at ~ 100 throughout the frequency range studied, with an average temp. coeff. of -8.2×10^{-4} per °C. In the infra-red region it falls off. The power factor decreases with increasing frequency to 0.0005 at 10° cycles. ϵ for mixtures of rutile with other dielectrics follows a logarithmic mixture formula. The high val. of ϵ is explained by a mechanism based on the Clausius-Mosotti equation. L. J. J.

Dipole moment and bond character in organometallic compounds.—See A., 1941, II, 245.

Molecular volume of saturated hydrocarbons. S. S. Kurtz, jun., and M. R. Lipkin (*Ind. Eng. Chem.*, 1941, 33, 779—786).—The mol. vol. (V) of saturated hydrocarbons can be represented by $V = 16.28n_1 + 13.15n_2 + 9.7n_3 + 31.2$, where n_1 , n_2 , and n_3 are the nos. of chain, ring, and ring-junction C atoms, respectively. The relation is used to calculate d -at. wt. curves for paraffins and various classes of naphthenes. It is suggested that the difference in d between naphthenes of equal mol. wt. and equal nos. of rings per mol. can be used to calculate the average no. of C atoms per ring. The relation also indicates that Staudinger's hydrocyclorubber contains 60—62% of ring CH_2 groups and 38—40% of chain CH_2 groups. J. W. S.

Critical temperature from index of refraction. S. W. Wan (*J. Physical Chem.*, 1941, 45, 903—907).—The expression $T_c = k_1R + k_2$ has been deduced as a linear relation between crit. temp. (T_c) and mol. refraction (R). Data for six types of aliphatic compounds have been used to test the expression, and vals. of k_1 and k_2 for each type of compound have been evaluated. The agreement between observed and calc. T_c vals. is good. C. R. H.

Rotatory powers of camphoranilic acids, α - and β -naphthylcamphoramic acids.—See A., 1941, II, 299.

Magneto-optic rotation. III. Carbon disulphide in substituted benzenes. C. E. Waring, H. H. Hyman, and S. Steingiser (*J. Amer. Chem. Soc.*, 1941, 63, 1985—1988; cf. A., 1940, I, 403).—Verdet consts., ρ , and n for solutions of CS_2 in PhMe, PhCl, PhBr, PhNO₂, and cyclohexane have been measured at 25°. A resonance structure is postulated for liquid CS_2 . W. R. A.

Lifetime of activated triatomic molecules and the mechanism of predissociation of nitrosyl chloride. G. L. Natanson (*Acta Physicochim. U.R.S.S.*, 1940, 13, 317—326).—Rosen's formula (A., 1934, 7) for the probability of transition of vibrational energy between the bonds of a linear triat. mol., leading to the dissociation of one of them, is extended to include complex transitions through intermediate quantum states, which shorten considerably the lifetime of an activated mol. to the moment of its dissociation. The theory is applied to the NOCl mol., and it is shown that the interpretation of its predissociation as a vibrational predissociation avoids the assumption of an unknown very low excited level of the NO mol. (A., 1939, I, 550). J. W. S.

Hydrogen bond. R. M. Barrer (*J. Soc. Dyers and Col.*, 1941, 57, 264—268).—H-bonds are of various strengths characterised by differing distances between the bonded atoms, e.g., (i) OH bonds (Bernal *et al.*, A., 1935, 1307); (ii) those of intermediate strength as in the fatty acid dimers; (iii) extremely strong as in $\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ or KH_2PO_4 . The bonding power of H is not primarily due to co-ordinate linkings being formed; it increases in the order (for ions) $\text{Cl} < \text{N} < \text{O} < \text{F}$, i.e., increasing order of electron affinity. The alternating stability and shorter distances between the bonded atoms in (iii) are ascribed to resonance. The possibility of H-bonds in proteins is discussed. H. B.

Investigation by electron diffraction of the structures of tetrahalides. M. W. Lister and L. E. Sutton (*Trans. Faraday Soc.*, 1941, 37, 393—406; cf. A., 1939, I, 307).—Data are recorded for CBr_4 , Cl_4 , SiBr_4 , SiI_4 , GeBr_4 , GeI_4 , SnBr_4 , SnI_4 , PbCl_4 , TiCl_4 , ZrCl_4 , ThCl_4 , and SeCl_4 . In all compounds in which the configuration would significantly affect the mode of scattering the assumption of a tetrahedral mol. is satisfactory. Bond lengths are tabulated; they are mostly < the sum of the covalent at. radii. F. L. U.

Covalency, ionisation, and resonance in carbon bonds. E. C. Baughan, M. G. Evans, and M. Polanyi (*Trans. Faraday Soc.*, 1941, 37, 377—393).—The properties and electrolytic dissociation of bonds between (a) Me and (b) H, halogen, and

Na are discussed in terms of the potential energy curves of the ground and ionic states of these bonds and their resulting ionic resonance energy. By considering also the additional resonance of alkyl radicals between several canonical forms the observed bond strengths and dipole moments of some alkyl compounds are explained. Applications of the theory to the proton affinity of C_2H_4 , the solvolysis of alkyl halides, and the reaction of Na with hydrocarbons are also discussed.

F. L. U.

Resonance energies of unsaturated and aromatic molecules. G. W. Wheland (*J. Amer. Chem. Soc.*, 1941, **63**, 2025—2027).—A simplification of the method of Mulliken and Rieke (*ibid.*, 1770) is developed and applied to unsaturated mols. and free radicals. The inclusion of the non-orthogonality integral, S , in the mol. orbital treatment makes no appreciable difference in the self-consistency of calculation of resonance energies of the mols. or free radicals considered.

W. R. A.

Structure of alicyclic compounds. V. G. Aston, S. C. Schumann, H. L. Fink, and P. M. Doty (*J. Amer. Chem. Soc.*, 1941, **63**, 2029—2030).—The entropy of cyclopentane has been calc. at various temp. for the symmetry structures, D_{5h} , C_2 , and C_5 . The calorimetric val. agrees best with the calc. val. for the non-planar configuration C_2 , symmetry no., σ , = 1. A similar result is found for methylcyclopentane. cycloHexane has σ = 6.

W. R. A.

Structure of vinyl co-polymerides. F. T. Wall (*J. Amer. Chem. Soc.*, 1941, **63**, 1862—1866).—The structure of co-polymerides is considered theoretically and it is concluded that an ordinary co-polymeride consists of a mixture of polymerides subject to a composition distribution function. A "true co-polymeride" is defined as consisting of individual chains of the same composition (within reasonable statistical fluctuations) as the mass of the polymeride. The experimental conditions governing the formation of a "true co-polymeride" are briefly discussed. The intramol. distribution of monomer units within polymeride chains is considered. Preliminary experimental results on co-polymerides of vinyl chloride and acetate are in accord with theory as to both rates of polymerisation and removal of Cl by Zn.

W. R. A.

Complex formation. N. V. Sidgwick (*J.C.S.*, 1941, 433—443).—Liversidge lecture. The structures of co-ordination compounds are discussed with reference to the electronic properties of the acceptor and donor mols.

O. D. S.

Constants of the Beattie-Bridgman equation. J. Corner (*Trans. Faraday Soc.*, 1941, **37**, 358—361).—The third virial coeffs. calc. by de Boer and Michels (cf. A., 1939, I, 248) can be used to interpret the consts. a and b of the Beattie-Bridgman equation.

F. L. U.

Measurement of contact angles. A. Ferguson (*Proc. Physical Soc.*, 1941, **53**, 554—568).—A lecture. The problem is examined mathematically, and available experimental methods are discussed.

N. M. B.

III.—CRYSTAL STRUCTURE.

Optical methods for study of molecular structure: X-ray method. B. E. Warren (*J. Opt. Soc. Amer.*, 1940, **10**, 369—373).—A review of X-ray diffraction methods and results in the study of mol. structure in the gaseous, liquid, and, in particular, the cryst. state.

O. D. S.

Classical and quantum reflexions of X-rays. (Sir) C. V. Raman and P. Nilakantan (*Physical Rev.*, 1941, [ii], **60**, 63—64).—Various considerations refute the suggestion that the modified or quantum reflexion (cf. A., 1940, I, 348) may be explained as "diffuse maxima in the scattering of X-rays by elastic waves of thermal origin" (cf. Zachariasen, A., 1941, I, 324; Siegel, *ibid.*, 195; Jahn, *ibid.*, 102).

N. M. B.

Accurate evaluation of lattice spacings from back-reflexion powder photographs. S. S. Lu and Y. L. Chang (*Proc. Physical Soc.*, 1941, **53**, 517—528).—Methods have been devised for the correction of all systematic errors. For cubic crystals, the observed lattice spacings plotted against $\cos \phi$, where ϕ is the supplement of the angle of deviation, give a straight line. The extrapolation to $\cos \phi = 1$ gives the corr. lattice const. Non-cubic crystals require an analytical method. The systematic errors will make $\cos^2 (\phi/2)$ inaccurate by an amount $\propto \sin^2 \phi$, which may thus be introduced as a correction term to the Bragg equation in the quadratic

form. Determinations, accurate to ~ 1 in 50,000, of the lattice spacings of very pure Al, α -Fe, Ni, Cu, Mo, W, Pb, Cd, and Sb are given.

N. M. B.

Secondary diffraction effect on Laue photographs of diamond. K. Lonsdale and H. Smith (*Proc. Physical Soc.*, 1941, **53**, 529—531).—With normal apparatus and X-rays from a Cu or Fe target, well-exposed Laue photographs of diamond sometimes show sharp diffraction curves around (111), (220), or (113) Laue spots. These curves are due to secondary diffraction by the black paper (light-tight) cover of the film-holder, and occur only when the crystal is correctly set, to within $\pm 0.3^\circ$, for selective reflexion of the characteristic $K\alpha$ or β radiation from one of these strongly reflecting diamond planes. The effect is a useful indication of correct crystal setting for monochromatisation, and provides a measure of the width of the monochromatised beam, but may introduce error in intensity measurements, especially with long- λ radiation.

N. M. B.

Structure and molecular anisotropy of sorbic acid, $CHMe:CH:CH:CH:CO_2H$. K. Lonsdale, J. M. Robertson, and I. Woodward (*Proc. Roy. Soc.*, 1941, **A**, 178, 43—52).—The monoclinic unit cell contains eight mols. linked in pairs by H bonds about the symmetry centres of the crystal; the long chain axis of the mol. lies near the (010) plane and is inclined at between 10° and 15° to the a axis. The mol. chains are turned about their axes so as to bring some of the atoms out of the (010) plane. The magnetic and optical anisotropies provide an approx. measure of this rotation. The orientation of the mols. has been confirmed by observation of the size and shape of the diffuse spots recorded on well-exposed Laue photographs taken with a Cu target. The usefulness of these spots as a secondary method of structure determination is emphasised.

G. D. P.

Bond lengths and resonance in the *cis*-azobenzene molecule G. C. Hampson and J. M. Robertson (*J.C.S.*, 1941, 409—413; cf. Robertson, A., 1939, I, 186).—A determination of the structure of the *cis*-azobenzene mol. has been carried out by the Fourier analysis of the X-ray diagram of the cryst. substance. The mol. is not coplanar, the two Ph rings being rotated so that the distance between the o and o' C atoms is 3.34 Å. Differences in the lengths of the N—N and C—N bonds from those observed in the *trans*-azobenzene mol. (*ibid.*) indicate that resonance with the C=N double bond structure is suppressed in the *cis*-compound owing to steric hindrance. Distortion of the valency angles is also observed.

O. D. S.

X-Ray analysis of protein denaturation.—See A., 1941, II, 306.

Proteins.—See A., 1941, II, 113, 114, 306.

Optical methods for study of molecular structure: electronic diffraction method. L. R. Maxwell (*J. Opt. Soc. Amer.*, 1940, **10**, 374—395).—A review of the methods and results of electron diffraction investigation of mol. structure in the gaseous state. Data for mol. structures, as published up to 1940, are tabulated.

O. D. S.

Investigation by electron diffraction of dihalides of cadmium, tin, and lead. M. W. Lister and L. E. Sutton (*Trans. Faraday Soc.*, 1941, **37**, 406—419).—Examination of electron diffraction patterns of vapours of the dihalides (excluding fluorides) of Cd, Sn, and Pb indicates that the valency angle in the Cd compounds is probably 180° , and is $< 180^\circ$ in the Sn and Pb compounds. Bond lengths are calc. The Cd-halogen bond lengths are $<$ the sums of the appropriate covalent radii, but no contraction is observed for the Sn and Pb compounds; this is interpreted as meaning that the covalencies in Sn^{II} and Pb^{II} compounds involve only p -orbitals on the metal atom.

F. L. U.

Geometrical crystallography of PbO_2 and Pb_3O_4 . H. R. Davidson (*Amer. Min.*, 1941, **26**, 18—24).—Large crystals of PbO_2 and Pb_3O_4 have been obtained by heating PbO_2 , NaOH, and H_2O for 4—6 days at 260 — 390° in a Au-lined steel bomb. At higher temp., some yellow flakes of PbO are formed. Both the PbO_2 (c 0.6785) and the Pb_3O_4 (c 0.989) are tetragonal. The crystallographic forms obtained are described.

L. S. T.

Crystal structure of coumarin. S. R. Swamy (*Current Sci.*, 1941, **10**, 197—198).—Coumarin has a 15.44, b 7.92, c 5.66 Å., space-group C_2^2 . The c -axis is normal to the optic axial

plane, and the crystal is positive with the acute bisectrix parallel to the b -axis. Diamagnetic anisotropy vals. $[(\chi_p - \chi_g)_M]$ [P. Nilakantan] are: $pq = ac$, 31.8; ab , 109; cb , 79.0×10^{-6} , i.e., $\chi_b > \chi_c > \chi_a$. It is concluded that the plane of the mol. is parallel to the ac plane, with the longest dimension approx. parallel to the a -axis. A. J. E. W.

New technique for preparing monocrystalline metal surfaces for work function study. Work function of Ag (100). P. A. Anderson (*Physical Rev.*, 1941, [ii], 59, 1034—1041; cf. A., 1940, I, 147).—The structural dependence of the work functions was studied by a method depending on the formation of metallic films, which are in effect single crystals with a (100) plane parallel to NaCl (100), when cubic lattice metals are condensed on heated cleavages of rock-salt. A Ag-rock-salt film was prepared in the measuring tube and its contact p.d. determined against polycryst. Ag films on glass at room temp. and against a reference metal (Ba) of known work function. The contact p.d. vals. are Ag (rock-salt)-Ag (glass), $\sim 0.32 \pm 0.03$ and Ag (glass)-Ba, 1.95 v.; the corresponding calc. work functions are Ag (glass) 4.47 and Ag (rock-salt) 4.79 e.v., the latter being tentatively identified with the work function of Ag (100). N. M. B.

Magnetostriction, Young's modulus, and damping of 68 Permalloy as dependent on magnetisation and heat-treatment. H. J. Williams, R. M. Bozorth, and H. Christensen (*Physical Rev.*, 1940, [ii], 59, 1005—1012).—Magnetostriction varied with heat-treatment from 2.5×10^{-6} to 22×10^{-6} . The variation in change of Young's modulus, E , with magnetisation to saturation was 0.09—10.5%. The damping of mechanical vibrations was measured as dependent on magnetisation and heat-treatment. E and the damping const. were determined by measuring the natural frequency of vibration and the width of the resonance curve of a hollow rectangle magnetised parallel to its sides. Results are considered in relation to the domain theory. N. M. B.

Contact electrification of solid particles. R. Schnurmann (*Proc. Physical Soc.*, 1941, 53, 547—553).—The sign of the acquired charge was determined for metal particles poured from SiO_2 or glass containers, and for particles of various dielectrics poured from SiO_2 , glass, or metal containers. The particles convey their charge to a closed insulated funnel; when this charge is removed and the particles stream from the funnel, the latter again acquires a certain charge and the particles carry the opposite charge to the receptacle. Some acquired charges are: Cu filings (+) from a glass or SiO_2 container; SiO_2 (—) from a Cu trough; bulk SiO_2 (+) when rubbed against bulk Cu; Sb powder (—) from a glass or SiO_2 container; glass or SiO_2 (+) when rubbed against bulk Sb. Explanations are discussed. N. M. B.

Stress-strain curve for the atomic lattice of iron. S. L. Smith and W. A. Wood (*Proc. Roy. Soc.*, 1941, A, 178, 93—106).—The stress-strain relation for Fe of 99.95% purity was measured by an extensometer and the changes in lattice parameter were simultaneously recorded. Up to the yield point the lattice contraction, measured in a direction perpendicular to the applied stress, \propto the stress. Beyond the yield point the contraction slows down and a tendency to expansion sets in before fracture. In a further set of experiments the test-piece was subjected to a cycle of stress and it was found that on the removal of stresses exceeding the yield stress a permanent lattice expansion exists in the metal. The bearing of these results on the internal strains in the metal is discussed. It is shown that the residual expansion in the lattice after stresses $>$ the yield stress is removed by short heat-treatment at 300° , considerably below the recrystallisation temp. of the metal. G. D. P.

IV.—PHYSICAL PROPERTIES OF PURE SUBSTANCES.

Superconducting films as radiometric receivers. D. H. Andrews, W. F. Brucksch, jun., W. T. Ziegler, and E. R. Blanchard (*Physical Rev.*, 1941, [ii], 59, 1045—1046; cf. Goetz, A., 1939, I, 490).—Preliminary results obtained with Pb films evaporated on glass are reported. N. M. B.

Magnetic susceptibilities of halides. G. Farid (*Current Sci.*, 1940, 9, 492—493).—Vals. of χ ($\times 10^6$) are given for SbOCl —2.30; ("C trichlorate" —2.44; $\text{Pr}_2\text{Cl}_6 + \text{H}_2\text{O}$ +0.18; $\text{C}_6\text{H}_{11}\text{NCl}$ —5.27; $(\text{CH}_2\text{NH}_2)_2\text{HCl}$ —0.79; aq. Cr_2Cl_6 +3.98;

$\text{FeCl}_2 + \text{H}_2\text{O} + 55.56$; $\text{CrCl}_2 + 30.91$; $\text{TaCl}_5 + 0.39$; $\text{ThCl}_4 + 8\text{H}_2\text{O}$ —0.34. W. R. A.

Determination of the vapour pressure curve of liquid helium below 1.6°K . using a magnetic thermometer. B. Bleaney and R. A. Hull (*Proc. Roy. Soc.*, 1941, A, 178, 74—85).—The determination was carried out using the susceptibility of Mn NH_4 sulphate and of K Cr alum as the thermometer. The results agree with the theoretical curve within 0.004° down to 1°K . but differ from previous experimental work. G. D. P.

Effective susceptibility of a paramagnetic powder. B. Bleaney and R. A. Hull (*Proc. Roy. Soc.*, 1941, A, 178, 86—92).—The effective susceptibility of a paramagnetic powder loosely packed into an ellipsoidal container was measured against the v.p. of liquid He and hence against the susceptibility of the compact salt (cf. preceding abstract). The results show that the theoretical expression for the demagnetising field derived for certain special forms of space lattice can be used in the general case of a powder formed by crushing salt crystals. G. D. P.

Composition of Prussian and Turnbull's blues. VI. Magnetic susceptibility. A. K. Bhattacharya (*J. Indian Chem. Soc.*, 1941, 18, 85—88; cf. A., 1941, I, 385).—The magnetic susceptibilities (χ) of Prussian blue (I) and Turnbull's blue (II) are ~ 19.5 and ~ 21 Weiss magnetons per g.-atom of Fe, respectively, whereas the calc. vals. are 16.5 and 19.6 Weiss magnetons, respectively. Samples of (I) and (II) aged in contact with their mother-liquors tend to attain equal χ , indicating their tendency to become identical in composition. Slight variations of χ with changing concns. of the solutions used in pptn. are attributed to the effects of adsorption on the compositions of the compounds. J. W. S.

Sound velocities in gases under different pressures. R. C. Colwell and L. H. Gibson (*J. Acoust. Soc. Amer.*, 1941, 12, 436—437).—The velocity of sound in gases can be measured over short distances by producing sound pulses in the gas with a loud speaker, picking them up with a microphone, and passing them into an oscilloscope. The apparatus was used with air, N_2 , and CO_2 , the measured velocities being 331.42, 337.12, and 258.57 m. per sec., respectively, and independent of pressure. A. J. M.

Ultrasonic absorption and velocity measurements in numerous liquids. G. W. Willard (*J. Acoust. Soc. Amer.*, 1941, 12, 438—448).—The velocity and absorption of ultrasonic waves in about 40 org. liquids, mixtures of liquids, solutions of solids, and a gel were determined over the frequency range 6—30 megacycles by the diffraction method. In general, the velocity is independent of frequency, and the absorption $\propto (\text{frequency})^2$, and is not connected with viscous and thermal losses. Absorption errors due to sound diffraction and spreading are considered, and a simple method of estimating them is proposed. A. J. M.

Absorption of sound in CO_2 , N_2O , COS , and CS_2 , containing added impurities. V. O. Knudsen and E. Fricke (*J. Acoust. Soc. Amer.*, 1941, 12, 449).—A correction (cf. A., 1941, I, 34). A. J. M.

Optical reflexion factors of acoustical materials. P. Moon (*J. Opt. Soc. Amer.*, 1941, 31, 317—324).—Reflexion factors and trichromatic coeffs. are given for 100 samples of acoustical materials and insulating boards. L. J. J.

Thin evaporated silver films on glass. J. Strong and B. Dibble (*J. Opt. Soc. Amer.*, 1940, 30, 431—438).—Measurements of the reflectivity and transmittivity of evaporated Ag films on glass for bands with centres at 6150, 5400, and 4650 Å. show that films fall into two well-defined classes. α -Films, mainly of high density $> 4 \mu\text{g}$. Ag per sq. cm., have high efficiencies, appear blue by transmitted light, and show no scattering. As the density of the films is increased their properties vary continuously towards those of massive Ag. β -Films, mainly of density $< 10 \mu\text{g}$. Ag per sq. cm., show low efficiencies, vary in colour from reddish-yellow to blue with increasing density, and show scattering. The properties of ultra-penumbra deposits formed at the back of the collecting plate during evaporation are similar to those of β -films and the characteristic β -film properties can be observed to higher densities than in directly evaporated films. Published data for the optical properties of sputtered films (Goos, A., 1936, 769) are found to be similar to the β -type for densities

<25 $\mu\text{g.}$ per sq. cm. and to the α -type for densities >30 $\mu\text{g.}$ per sq. cm. The structure of β -films is discussed.

O. D. S.
Specific heat of the sodium chloride crystal. E. W. Kellerman (*Proc. Roy. Soc.*, 1941, **A**, 178, 17–24).—The sp. heat of NaCl is calc. from a determination of some 280 proper frequencies of the crystal lattice. Good agreement with experiment is obtained; the errors in Debye's theory are shown to arise from the assumption of ν^2 law for the frequency distribution.
 G. D. P.

Heat capacities and entropies of aluminium and copper from 15° to 300° K. W. F. Giauque and P. F. Meads (*J. Amer. Chem. Soc.*, 1941, **63**, 1897–1901).—Vals. of C_p for single crystals of Al and Cu have been measured from 15° to 300° K.; they are slightly > those for harder forms produced by cold-working. The entropies at 25° are 6.77 g.-cal. per degree per g.-atom for Al and 7.97 for Cu but these vals. do not include the entropy due to nuclear spin and isotopic mixtures. Free energy and heat content vals. from 15° to 300° K. are given for both.
 W. R. A.

Heat capacities and entropies of silver and lead from 15° to 300° K. P. F. Meads, W. R. Forsythe, and W. F. Giauque (*J. Amer. Chem. Soc.*, 1941, **63**, 1902–1905).—The heat capacities of single crystals of Ag and Pb have been measured from 15° to 300° K. and thermodynamic properties have been derived. The entropies at 298.1° K. are 10.21 g.-cal. per degree per mol. for Ag and 15.51 for Pb. C_p vals. for Al, Cu (see preceding abstract), Ag, and Pb are compared by the Debye equation.
 W. R. A.

Heat capacities of organic vapours. C. J. Dobratz (*Ind. Eng. Chem.*, 1941, **33**, 759–762).—The method of calculating heat capacities of org. vapours from valency bond frequencies (A., 1938, I, 303) has been extended by including rotation within the mol. Frequencies have been assigned to linkings involving halogens, N, and S; these, combined with vals. assigned previously to linkings involving C, H, and O atoms, permit the calculation of the heat capacities of the vapours of most org. compounds with an accuracy of $\pm 5\%$.
 J. W. S.

M.p. of tellurium. F. C. Kracek (*J. Amer. Chem. Soc.*, 1941, **63**, 1989–1990).—Electrolytic Te, purified by vac. distillation in Pyrex at $\sim 575^\circ$, has m.p. $449.8 \pm 0.2^\circ$.
 W. R. A.

Calculation of b.p. of aromatic hydrocarbons. C. R. Kinney (*Ind. Eng. Chem.*, 1941, **33**, 791–794; cf. A., 1939, I, 134; 1940, I, 16, 247).—The method of calculating b.p. from mol. structure has been extended to aromatic hydrocarbons. By taking the b.p. no. (B.P.N.) of C_6H_6 as 20, and suitable vals. for substituent groups, dependent on their relative positions, the method can be applied to the calculation of the b.p. of C_6H_6 , Ph_2 , and $\text{C}_6\text{H}_4\text{Ph}_2$ compounds. The method also permits the setting of certain limitations on the structure of a hydrocarbon if its b.p. and mol. formula are known.
 J. W. S.

Second virial coefficient of acetaldehyde. E. A. Alexander and J. D. Lambert (*Trans. Faraday Soc.*, 1941, **37**, 421–426).—The second virial coeff. (B) of MeCHO has been obtained from $PV-P$ measurements at a series of temp. between 15° and 300°. Comparison with vals. of B calc. from crit. data shows a large discrepancy at lower temp. This is not due to adsorption, but is accounted for by assuming polymerisation with a heat of 5226 g.-cal. per mol.
 F. L. U.

Theory of the liquid state. I. Statistical treatment of the thermodynamics of liquids by the theory of holes. II. Application of the hole theory to superheated liquids and supersaturated solutions of gases in liquids. III. Hole theory of the viscous flow of liquids. R. Firth (*Proc. Camb. Phil. Soc.*, 1941, **37**, 252–275, 276–280, 281–290; cf. A., 1941, I, 106).—I. The previously developed theory of the liquid state is developed by classical statistical mechanics. The mean size v_m at the triple point of the "holes" is calc. for a no. of metals to be $\gg v_a$, the at. vol. of the metals. For some non-metals and chemical compounds v_m is of the same order as v_a . The compressibility κ of a liquid is expressed as the sum of the compressibility κ^* of the "holes" in the liquid and a factor representing the κ of that part of the liquid which is in a state approximating to the cryst. In accordance with this view the calc. val. of κ^* at the triple point is in general < the experimental val. of κ at the m.p. A similar expression for the coeff. of thermal expansion agrees with

the experimental val. An expression for the ratio of the sp. heats c_p/c_v is derived and agrees with experiment. It is deduced that the sp. heat of a metal should increase by ~ 1 g.-cal. per mol. on fusion and this is in fair agreement with experiment.

II. A case of metastable equilibrium in the growth of small "holes," described in Part I, is identified with the superheated state of liquids and supersaturated solutions of gases in liquids. The main properties of the supersaturated state are accounted for.

III. Expressions for the abs. val. of the viscosity of a liquid and its dependence on temp. are deduced, and agree with experiment.
 O. D. S.

Helium the superfluid. K. K. Darrow (*Rev. Mod. Physics*, 1940, **12**, 257–266).—A lecture.
 W. R. A.

Liquid He II. H. Hsü and W. Band (*Physical Rev.*, 1941, [ii], **59**, 1013–1018).—Mathematical. A treatment of the equilibrium between the two competing sets of states of atoms in a two-dimensional surface monolayer and the normal three-dimensional body of the liquid, with reference to Einstein-Bose statistics and the Einstein λ -point. The theory explains the thermomechanical or "fountain" effect and suggests an interpretation of the surface transfer phenomena.
 N. M. B.

Supercooled silicates and their importance in considerations of the liquid state. E. Preston (*Proc. Physical Soc.*, 1941, **53**, 568–584).—A study of crystallisation, viscosity, electrical conductivity, and surface tension shows that silicate glasses are supercooled liquids and may be regarded as solutions, the constituents of which are associated to a degree depending on composition and temp. Recent researches on the structure of glasses by X-ray methods indicate that it is typical of the liquid state. Glass at room temp. has a static structure as opposed to the dynamic configuration of the particles of a normal liquid, and hence simple glasses may assist the elucidation and provision of an adequate theory of the structure of liquids.
 N. M. B.

Temperature coefficient of static friction. R. Schnurmunn (*Proc. Physical Soc.*, 1941, **53**, 538–546).—Angles of repose of metals were measured under controlled vac. conditions for steel, Cu, Al, and Cd sliding rods on similar crutches and on naked metal (Al and Cd) surfaces obtained by cleaning by volatilisation in high vac., and on Al volatilised on steel. Experiments on Cd at 176° to -100° in a baked-out friction chamber show a general drift with temp. and are an approach to the thermodynamical criterion for the fundamental mechanism of friction between naked metal surfaces. Analysis of measurements between -100° and 100° leads to a temp. coeff. $(-3.5 \text{ to } 8) \times 10^{-2}$ degrees of the angle of repose. Above $\sim 100^\circ$ the angle of repose of naked Cd increases with rising temp.
 N. M. B.

V.—SOLUTIONS AND MIXTURES (INCLUDING COLLOIDS).

Thermal conductivity of binary systems: air-sulphur dioxide, air-diethyl ether, and air-benzene. F. Ishikawa and J. Abe (*Bull. Inst. Phys. Chem. Res. Japan*, 1941, **20**, 292–300).—The thermal conductivity of the binary mixtures was measured at 25° under various total pressures. The conductivity curves are convex to the composition axis except for the air- C_6H_6 mixture at 300 mm., which is linear. SO_2 and org. vapours in air may be determined with an accuracy of 0.15% by the thermal conductivity method.
 W. R. A.

Thermal diffusion coefficient for isotopes. II. R. C. Jones (*Physical Rev.*, 1941, [ii], **59**, 1019–1033; cf. A., 1940, I, 389).—Mathematical. A general treatment of the 9,5 Lennard-Jones model of intermol. forces indicates that the thermal diffusion const. first increases slightly with fall of temp., then decreases rapidly, passing through zero and becoming negative at ~ 1.5 times the crit. temp.; it then becomes strongly negative with further fall of temp., and approaches zero as the temp. approaches 0° K. Results are discussed with reference to available experimental data.
 N. M. B.

$i\xi$ - and $s\xi$ -nomograms for the system benzene-water vapour. S. V. Balian (*J. Appl. Chem. Russ.*, 1940, **13**, 1612–1619).—Nomograms are given, with examples of their use.
 R. T.

Heat capacity and density of aqueous solutions of potassium iodate, potassium hydrogen sulphate, iodic acid, and sulphuric acid at 25°. M. Randall and M. D. Taylor (*J. Physical Chem.*, 1941, 45, 959—967).—Heat capacities at 25° of aq. solutions of HIO_3 , KIO_3 , KHSO_4 , and H_2SO_4 have been determined, and the partial mol. heat capacities (\bar{c}_p) of the constituents of the solutions have been calc. When \bar{c}_p is plotted against $m^{0.5}$ (m = molarity) the curves are very steep as m approaches 0. This behaviour can be explained by assuming that HIO_3 and HSO_4^- are weak acids; a similar explanation seems applicable to data for AcOH and citric acid. C. R. H.

Cryoscopic investigation of some halides of lithium, rubidium, and caesium in a nitrobenzene solution of aluminium bromide. J. P. Meshenni (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, 7, 363—373).—F.p. of PhNO_2 solutions containing 0 to 1 mol. of LiCl , RbCl , CsCl , or RbI to 1 mol. of AlBr_3 in 15—25 mols. of PhNO_2 were determined. All the halides used appear to have the normal mol. wt.; this behaviour is presumably due to formation of a compound $\text{M}[\text{AlBr}_3\text{Cl}]$ and its complete dissociation into M^+ and $[\text{AlBr}_3\text{Cl}]^-$. J. J. B.

Persistence of fine structure of faces of growing sodium chloride crystals. I. Deposition of solid and supersaturation at different stages of growth of sodium chloride crystals. G. Nitschmann. II. Morphological development of faces of growing sodium chloride crystals of type I with high supersaturation. K. Spangenberg and G. Nitschmann (*Z. Krist.*, 1940, 102, 285—308, 309—344; cf. A., 1939, I, 129; Nitschmann, *Diss.*, Breslau, 1939).—I. A further detailed study of the influence of supersaturation and other factors on the mode and rate of growth of NaCl crystals from aq. solutions. Under specified conditions growth does not occur from a slightly supersaturated solution, a region of "ineffective supersaturation" existing just above the saturation point.

II. The fine structure of faces in course of development is studied by goniometric measurements and "reflectograms," and the mechanism of growth and the effect of supersaturation are further considered. A. J. E. W.

Ineffective supersaturation region and alleged dependence of saturation concentration on crystal structure of the solid phase. K. Spangenberg (*Z. Krist.*, 1940, 102, 345—348).—The work of Balarev and Kolarov (A., 1941, I, 206) is discussed in relation to the results reported in the preceding abstract. A. J. E. W.

Crystallisation of ammonium chloride and bromide from aqueous solution, in presence of various cations. J. J. Tilman (*J. Gen. Chem. Russ.*, 1940, 10, 1631—1640).—The habit of NH_4Cl and NH_4Br crystals separating from aq. solutions of these salts changes from dendrites to cubes, through a series of intermediate forms, as the concn. of chlorides of various other metals rises. The effectiveness of various cations falls in the order $\text{Cd} > \text{Cu}^I > \text{Cr}^{III} > \text{Fe}^{III} > \text{Mn}^{II} > \text{Cu}^{II} > \text{Ni}^{II} > \text{Co}^{II} > \text{Fe}^{II} > \text{Zn} > \text{Mg} > \text{Ca} > \text{Be} > \text{Sr} > \text{Na}$. The higher is the temp. of saturation of the solution, the greater is the concn. of added salt necessary to modify the crystal form. R. T.

Theory of diffusion in solids. I. Dependence of the coefficient of diffusion in solids on concentration. G. P. Ilkevitch (*Physical Trans. Ukrain. Acad. Sci.*, 1940, 9, 29—38).—The diffusion is considered as the statistical result of place exchanges in crystal lattices. Coeffs. are calc. for the mutual interdiffusion of two components; both coeffs. decrease when the concn. of the diffusing substance increases. J. J. B.

Certain singular points on crystallisation curves of solid solutions. N. L. Bowen (*Proc. Nat. Acad. Sci.*, 1941, 27, 301—309).—Ternary systems in which two of the components form a complete series of solid solutions with a min. m.p., while each of them forms a eutectic with the third component, are considered. The relation between fractional and equilibrium crystallisation is discussed. It is possible to obtain curves of equilibrium crystallisation from those of fractional crystallisation by a simple construction, which is of particular val. in more complex cases. Inflection points on fractionation curves correspond with corner points on equilibrium curves. The physical significance of such points is discussed. A. J. M.

System sodium disilicate-barium disilicate. K. T. Greene and W. R. Morgan (*J. Amer. Ceram. Soc.*, 1941, 24, 111—116).

—The compounds form a true binary simple eutectic (at 797° and 32% of $\text{BaO} \cdot 2\text{SiO}_2$) without any intermediate compounds in the range studied [800—1418°, the m.p. of $\text{BaO} \cdot 2\text{SiO}_2$ (I)]. In the field of stability of (I), the glasses show a marked tendency to devitrification. Two types of (I) crystals exist, differing only in external form. The quenching method of examination was used. Measurements of η (immersion method) gave vals. from 1.505 for $\text{Na}_2\text{O} \cdot 2\text{SiO}_2$ to 1.610 for (I). J. A. S.

X-Ray study of lime-phosphate and lime-borate glass. J. Biscoe, A. G. Pincus, C. S. Smith, jun., and B. E. Warren (*J. Amer. Ceram. Soc.*, 1941, 24, 116—119).—In $\text{CaO-P}_2\text{O}_5$ glasses containing 23 and 28% of CaO , each P is tetrahedrally bonded to 4 O at a distance of 1.57 Å. and each O is bonded to either 1 or 2 P. The Ca^{++} are situated in the holes of the P-O network and have ~7 O neighbours. In the $\text{CaO-B}_2\text{O}_3$ glass (25% of CaO) some of the B atoms are triangularly bonded to 3 O atoms and the others are similarly tetrahedrally bonded. J. A. S.

Silicate glasses. Calculation of densities, refractive indices, and dispersions from glass composition.—See B., 1941, I, 405.

Phase equilibria in the system Al-Ag, as studied by thermal analysis and conductivity methods. E. E. Tscherskaschin and G. I. Petrenko (*J. Gen. Chem. Russ.*, 1940, 10, 1526—1530).

—The α -phase is a solid solution of Al in Ag; max. solubility (6%) is at 500°. The β -phase is stable at >600°, below which it breaks down to a eutectoid, consisting of γ (8.8% Al) and α -phase (6% Al). The β' -phase, corresponding with AlAg_3 , is stable below 400°, above which it breaks down to α - and γ -phase. The latter is a series of solid solutions of Al in AlAg_2 (limiting [Al] 14.33%). γ -Alloys containing 10—16% of Al disintegrate after a few months of exposure to air at room temp., yielding a powdery mixture of oxides. The δ -phase represents a series of solid solutions of Ag in Al (limiting [Ag] 48%). Conductivity data for tempered and quenched alloys show that the transformation $\alpha + \gamma \rightleftharpoons \beta'$ proceeds very slowly at 350° and 500°. R. T.

Atomic distribution in aluminium-silver alloys during ageing. C. S. Barrett and A. H. Geisler (*J. Appl. Physics*, 1940, 11, 733—739).—Laue photographs of Al-Ag alloys, rich in Al, during ageing at 20° and 150° show streaks along certain zonal ellipses in addition to the streaks caused by thermal agitation. These can only be explained as due to two-dimensional gratings parallel to planes of the form $\{111\}$, which arise during the early stages of the pptn. process. The streaks obtained at 20° are more diffuse than those at 150°, but when ageing takes place at 200° the phenomenon is not observed. At the beginning of the pptn. very thin plate-like nuclei occur on randomly spaced $\{111\}$ planes. These govern the orientation and shape of the Widmanstätten ppt. The nature of the nuclei is discussed. A. J. M.

Relation between pressure and solubility of gases in liquids. H. Sattler (*Oel u. Kohle*, 1941, 37, 230—234).—The Kritschewski-Kasarnovski formula (A., 1936, 29) for calculating the solubility of a gas in a liquid has been deduced on strictly thermodynamical principles for the cases of negligible and finite solvent v.p. and for gas mixtures. Analogous pressure formulae are deduced for the Ostwald, Bunsen, and Kuenen solubility coeffs. R. B. C.

Nomograph for the solubility of sulphur dioxide in water. D. S. Davis (*Ind. Eng. Chem.*, 1941, 33, 730).—A nomograph relating the partial pressure of SO_2 over its aq. solution with the temp. and composition of the solution has been constructed from the data of Beuschlein and Simenson (A., 1940, I, 206). J. W. S.

Solubility of chlorine in water. R. P. Whitney and J. E. Vivian (*Ind. Eng. Chem.*, 1941, 33, 741—744).—The solubility of Cl_2 in H_2O at 10°, 15°, 20°, and 25° has been determined by passing various Cl_2 - N_2 mixtures (partial pressure of Cl_2 0.06—1.0 atm.) through H_2O . The results are in accord with literature vals. and with the calc. data of Adams and Edmonds (B., 1937, 906). The hydrolysis consts. calc. on the assumption that unhydrolysed Cl_2 obeys Henry's law are < those obtained by Jakovkin (*J. Russ. Phys.-Chem. Soc.*, 1900, 32, 673). An equation which probably permits extrapolation of the solubility to partial pressures of Cl_2 > 1 atm. is derived. J. W. S.

Solubility of carbamide in water. H. Kakinuma (*J. Physical Chem.*, 1941, 45, 1045—1046).—A redetermination of the solubility of $\text{CO}(\text{NH}_2)_2$ in H_2O at 60—80° confirms the data of Shnidman and Sunier (cf. A., 1932, 687). C. R. H.

Retroflex aqueous solubility curves and the respective solubilities of the monohydrate and monodeuterate of manganous sulphate in ordinary and in deuterium water. R. D. Eddy, P. E. Machemcr, and A. W. C. Menzies (*J. Physical Chem.*, 1941, 45, 908—915).—The solubilities of $\text{MnSO}_4 \cdot \text{H}_2\text{O}$ in H_2O and of $\text{MnSO}_4 \cdot \text{D}_2\text{O}$ in D_2O have been determined at temp. $> 70^\circ$. The solubility of the hydrate is $>$ that of the deuterate at comparable temp., the difference in solubility increasing with temp. C. R. H.

Solubility in water of the barium, calcium, and magnesium salts of sulphamic acid. G. B. King and J. F. Hooper (*J. Physical Chem.*, 1941, 45, 938—942).—The solubility in H_2O of Ba, Ca, and Mg sulphamates over the range 0—100° has been determined. Solubility increases with rise in temp., the curve for the Ca salt showing a break at $69.40 \pm 0.05^\circ$, the temp. of transition of tetrahydrate into a lower hydrate or, possibly, into anhyd. salt. C. R. H.

Solubility in type I binary systems. E. I. Achumov (*J. Gen. Chem. Russ.*, 1940, 10, 1471—1489).—For the systems A—B, of Tammann's type I, the solubility x of A in B is expressed as $\log x = f_a \phi_a (1 - \theta_a) / 2\theta_a$, and of B in A as $\log (1 - x) = f_b \phi_b (1 - \theta_b) / 2\theta_b$, where $f_{a(b)}$ are empirical coeffs., analogous to Lewis' fusion coeffs., $\phi_{a(b)} = Q_{a(b)} / T_{a(b)}$ ($Q_{a(b)}$ is the heat of fusion of A or B, $T_{a(b)}$ their m.p.), and $\theta_{a(b)} = T / T_{a(b)}$, where T is the temp. of the system. Comparisons of solubilities of various substances at the same temp. are misleading; derived solubilities, as calc. from the above formulæ, are more suitable for certain purposes. R. T.

Ethylene and acetylene adsorption in hydrogenation catalysis. E. F. G. Herington (*Trans. Faraday Soc.*, 1941, 37, 361—366).—The geometric conditions for chemisorption of C_2H_4 and C_2H_2 on crystal facets of Ni and Co are discussed, and it is shown that C_2H_4 should be held on the short spacing 2.47 Å. and C_2H_2 on the long spacing 3.50 Å. The different behaviour of the two gases in the Fischer-Tropsch synthesis supports these views. F. L. U.

Sorption of mercury vapour by oxides and salts of metals. V. A. Piankov and M. L. Loeviski (*J. Appl. Chem. Russ.*, 1940, 13, 1559—1564).—The effectiveness of various compounds in removing Hg vapour from air rises in the order $\text{PbO}_2 < \text{MnO}_2 < \text{Ag}_2\text{O} < \text{CaOCl}_2$. The effect in the case of CaOCl_2 is not one of sorption, as HgCl is deposited in the tube beyond the layer of salt, and its effectiveness is greatly augmented by the presence of traces of acid gases (0.05% SO_2) in the air. KMnO_4 and CaOCl_2 in solution are effective in concns. of 0.3—0.5%. R. T.

Recovery of volatile solvents by sorption. V. Sorption on and desorption from active charcoal of ethyl acetate. E. V. Alexeevski and A. M. Mintel (*J. Appl. Chem. Russ.*, 1940, 13, 1565—1571).—Hydrolysis of esters (EtOAc and $\text{C}_2\text{H}_{11}\text{OAc}$) by boiling H_2O in presence of active C is $<$ in its absence, except in the case of C activated with ZnCl_2 . Desorption by means of steam at 110—120° is practically quant. in the case of C activated with H_3PO_4 , but not with ZnCl_2 . R. T.

Composition of Prussian and Turnbull's blues. IV. Adsorptive properties. A. K. Bhattacharya (*J. Indian Chem. Soc.*, 1941, 18, 71—75; cf. A., 1933, 920).—Prussian blue (I) prepared by mixing equiv. proportions of FeCl_3 and $\text{K}_4\text{Fe}(\text{CN})_6$ shows positive adsorption of both FeCl_3 and $\text{K}_4\text{Fe}(\text{CN})_6$, but when prepared in presence of excess of FeCl_3 shows negative adsorption of FeCl_3 . Turnbull's blue (II) prepared by mixing equiv. proportions of FeSO_4 and $\text{K}_3\text{Fe}(\text{CN})_6$ shows positive adsorption of $\text{K}_3\text{Fe}(\text{CN})_6$ and negative adsorption of FeSO_4 . The results support the view that both adsorption and oxidation-reduction reactions modify the final compositions of both (I) and (II). J. W. S.

Adsorption of potassium xanthate by galena.—See B., 1941, I, 402.

Surface tension of capillary-active organic halides. E. A. Hauser and G. E. Niles (*J. Physical Chem.*, 1941, 45, 954—959).—The surface tension (σ) of aq. solutions of cetyl, cetylpyridinium, and cetyltrimethylammonium chloride, bromide,

and iodide is recorded graphically. In each case σ decreases with increase in solute concn. C. R. H.

Tension mechanisms responsible for lens formation and a new method for measuring the angles of liquid lenses. N. F. Miller (*J. Physical Chem.*, 1941, 45, 1025—1045; cf. A., 1941, I, 166).—Earlier theories of lens formation and the spreading of liquids are discussed, and a theory limited to systems of two liquids of low mutual solubility where the liquid with the higher surface tension is the substrate is developed. Where lens formation occurs the magnitude of the total lens angle (θ) depends on the free energy decrease consequent on mol. orientation in the film on the substrate. A new method of measuring θ is described and data for ten org. liquids on H_2O which are presented agree with calc. vals. of θ . Vals. of 143 angles (corr. to $\pm 0.01^\circ$) of spherical segments of vols. 0.0005—0.0200 c.c. and of widths 0.25—1.00 cm. are tabulated. C. R. H.

Properties of films of helium II. A. K. Kikoin and B. G. Lasarev (*Physical Trans. Ukrain. Acad. Sci.*, 1940, 9, 101—106).—Further experiments on films rising along the walls of a body immersed in liquid He II are reported (cf. A., 1938, I, 511). Films are formed on Ag, celluloid, and glass. The heating current required to destroy them is higher for Ag than for insulators. The film moves on the surface with a velocity $\sim 10^4$ cm. per sec. J. J. B.

Cuprous-cupric oxide films on copper. C. G. Cruzan and H. A. Miley (*J. Appl. Physics*, 1940, 11, 631—634).—The composition of oxide films on an abraded Cu surface heated in air, or in air- O_2 and air- N_2 mixtures, has been studied by the electrolytic reduction method. Films < 400 Å. in thickness consist of Cu_2O only, all films > 800 Å. contain CuO and Cu_2O , and films of intermediate thickness may or may not contain CuO . The thickness of film obtained with a given time of heating increases with the $[\text{O}_2]$. The thickness of the film and the presence or absence of CuO are also affected in some degree by factors which influence the perviousness of the film and by previous thermal treatment. L. J. J.

Surface films of cerin, friedelin, and related substances.—See A., 1941, II, 265.

Structure of condensed unimolecular films. A. E. Alexander (*Trans. Faraday Soc.*, 1941, 37, 426—437).—Theories advanced to explain the force-area and surface potential-area curves of condensed monolayers are reviewed and discussed. The close correlation between two- and three-dimensional structures suggested by Dervichian (A., 1940, I, 22) is neither to be expected nor is it supported by recent experimental work. A no. of groups of compounds for which both force-area and surface potential data are available are discussed in detail, with special reference to the mode of packing and the dipole orientation. F. L. U.

Effect of monolayers of insoluble substances on the stability of bubbles (elements of foam). A. A. Trapeznikov (*Acta Physicochim. U.R.S.S.*, 1940, 13, 265—293).—Those substances which form brittle monolayers are less effective in stabilising foams than those which form liquid monolayers, conditions for stabilisation being the ability to form a continuous, mobile layer which can flow rapidly and without break of continuity into any ruptures that occur. Factors which influence the forces stretching the layers, e.g., hydration of polar groups, local thinning of the liquid film, liquid drainage, and ageing of the adsorption layers, are discussed with reference to foam stability. C. R. H.

Charge on aerosol particles in a dipolar ionic atmosphere. P. Lissovski (*Acta Physicochim. U.R.S.S.*, 1940, 13, 157—192).—Mainly theoretical. Formulæ for the average val. of the particle charge, for the ion concn. in the aerosol, and for the kinetics of the change in ion concn. and of the charging process have been derived. Data for radioactively charged mineral oil aerosols, which were obtained by ultramicroscopical and photographic oscillation methods, indicate that charging of the particles is not symmetrical, $\sim 10\%$ more negatively charged than positively charged particles being formed. The calc. distribution of charge is in good agreement with that found experimentally. C. R. H.

Optical properties of colloidal suspensions in relation to the measurement of particle-size frequency. E. G. Richardson (*J. Appl. Physics*, 1940, 11, 653—657).—Extinction coeffs. for a no. of suspensions of TiO_2 , S, and clay of known particle

size have been measured. The results are applied to the particle-size analysis of clay and pigment suspensions by extinction measurements carried out in a centrifuge.

L. J. J.
Preparation of organosols of heavy metals. E. M. Natanson (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, 7, 311—323).—Org. solvent is placed on top of an aq. salt solution in a beaker in which the cathode (a metal rod) vibrates up and down. The aq. layer contains the anode, and when the cathode is immersed in it a spongy deposit of the metal is obtained; when next the cathode returns to the org. layer the deposit disperses itself in the latter. The dispersion is promoted by detergents in the org. liquid. C_6H_6 , PhMe, castor oil, etc. were employed, and sols of Fe, Ni, Co, Pb, Bi, Sn, Ag, and Pt obtained.
J. J. B.

Nature of resin solutions in organic solvents.—See B., 1941, II, 312.

Inter-relationships in the reactions of horse hæmoglobin.—See A., 1941, III, 794.

Electro-optical field mapping. H. Mueller (*J. Opt. Soc. Amer.*, 1941, 31, 286—291).—Dilution of gels of yellow bentonite in which the particles are <20 μ in diameter gives a solution of Kerr const. 10 e.s.u. for 60-cycle a.c. fields. The high electro-optical birefringence enables inhomogeneous electric fields to be measured and studied. Isoclinic and isochromatic lines obtained by observation with crossed Polaroids give field direction and intensity at any point in the field. A.c. potentials <200 v. suffice.

L. J. J.
Influence of alcohols on the precipitate formation of the hydroxides of aluminium and iron. T. Katsurai and M. Fuda (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, 38, 328—330).—5 ml. of $N\text{-AlCl}_3$ or -FeCl_3 and 45 ml. of H_2O (MeOH, EtOH) are mixed with 5 ml. of $N\text{-aq. NH}_3$ and 45 ml. of H_2O (MeOH, EtOH) and the sedimentation vol. (R) is determined. R increases in presence of alcohol. When a $Fe^{II}\text{-Fe}^{III}$ mixture ($N\text{-FeSO}_4$ and $3N\text{-FeCl}_3$) is added to $7.5N\text{-aq. NH}_3$ in H_2O , MeOH, or EtOH, R increases in presence of alcohol and the ppt. formed is magnetic in H_2O but in alcohol is non-magnetic to a magnet inserted in the supernatant liquid.
W. R. A.

Irregular series in colloidal solutions by [the action of] electrolytes. III. Mercuric sulphide sols of various origin. N. Sata and K. Mōri (*Bull. Chem. Soc. Japan*, 1941, 18, 139—143; cf. A., 1940, I, 411).—Similar irregular series are obtained by the action of $AgNO_3$ on HgS sols prepared from $HgCl_2$, $HgSO_4$, $Hg(NO_3)_2$, and from carefully purified $Hg(CN)_2$. The phenomenon is considered not to depend on the presence of impurities nor, since the coagulating ion is univalent, on the reversal of charge due to adsorption.
F. L. U.

Periodic formation of deposits from solutions during their evaporation. III. N. F. Jermolenko, F. M. Laguto, M. N. Tiumantzeva, and S. Romanovitsch (*J. Gen. Chem. Russ.*, 1940, 10, 1565—1567).—Solutions of $PhOH$ and $C_{10}H_8$ in the alcohols ROH are evaporated in watch glasses at temp. $10^\circ <$ the b.p. of the solvent and at 50° , and the no. of rings formed is counted. It rises in the series $R = H < Me < Et < Pr^b < Pr^a < Bu^b < Bu^a < C_5H_{11}$; the reverse order holds for the surface tension of the solvents.
R. T.

Effect of formaldehyde on the isoelectric points of some proteins, determined by microelectrophoresis. S. J. Circle and A. K. Smith (*J. Physical Chem.*, 1941, 45, 916—930).—The general effect of addition of 10% of CH_2O to proteins is to lower the isoelectric point $0.1\text{--}0.7 p_H$ unit. Of the proteins investigated, viz., oil-free soya-bean meal, several soya-bean proteins, casein, gelatin, and ovalbumin, only the first was unaffected by CH_2O . Gelatin was unaffected by 5% of CH_2O and even with 20% of CH_2O the lowering of the isoelectric point was only $0.1 p_H$ unit. The greatest lowering was observed with electrodialysed ovalbumin and soya-bean "whey."
C. R. H.

Electrophoretic study of elementary bodies of vaccinia. Mixtures of elementary bodies of vaccinia and coated colloid particles.—See A., 1941, III, 630.

Electrokinetics. XXV. Electroviscous effect. II. Systems of calcium and sodium caseinates. C. L. Hankinson and D. R. Briggs (*J. Physical Chem.*, 1941, 45, 943—953).—Sp. conductivity, relative η , and electrokinetic potential data at 30° for solutions of Ca and Na caseinate in presence of $CaCl_2$

and NaCl respectively give straight lines when calc. and plotted as variables in the linear form of the electroviscosity equation (cf. A., 1941, I, 335). Electro- η accounts for 59% and 38% of the sp. η in 1% Ca and Na caseinate respectively. The conclusions which can be drawn from the data concerning combination between H_2O and colloid particles and the change in micelle size with concn. are similar to those drawn from data on Na gum arabic (*loc. cit.*).
C. R. H.

VI.—KINETIC THEORY. THERMODYNAMICS.

Free energy of methyl cyanide and equilibrium constants of related reactions. H. W. Thompson (*Trans. Faraday Soc.*, 1941, 37, 344—352).—Thermodynamic functions of CH_4 , C_2H_4 , C_2H_6 , C_2N_2 , and NH_3 are calc. from recent mol. data, and the entropy, free energy, and sp. heat of MeCN are obtained from the known moments of inertia and mol. vibration frequencies. Using the vals. so obtained, the gaseous equilibria $CH_4 + C_2N_2 \rightleftharpoons MeCN + HCN$, $2CH_4 + C_2N_2 \rightleftharpoons 2MeCN + H_2$, $C_2H_4 + 2HCN \rightleftharpoons 2MeCN$, $CH_4 + HCN \rightleftharpoons MeCN + H_2$, $C_2H_6 + C_2N_2 \rightleftharpoons 2MeCN$, $2C(\beta\text{-graphite}) + NH_3 \rightleftharpoons MeCN$, $CH_4 + CNCl \rightleftharpoons MeCN + HCl$, and $CH_4 + CNCl \rightleftharpoons MeCl + HCN$ are discussed and their equilibrium consts. computed.
F. L. U.

Dissociation of sulphuryl chloride. H. W. Thompson (*Trans. Faraday Soc.*, 1941, 37, 340—343).—The free energy of SO_2Cl_2 is calc. statistically from mol. data, and by combining the results with thermodynamic data for SO_2 and Cl_2 the equilibrium const. for the dissociation is obtained. Calc. and measured vals. show poor agreement, and the discrepancy is discussed.
F. L. U.

Physico-chemical study of the system aluminium bromide and sodium iodide in ethyl bromide. V. A. Plotnikov and V. N. Dumarevskaja (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, 7, 383—397).—The solubility of NaI in $AlBr_3\text{-EtBr}$ mixtures has a max. (12.9% of the resulting solution) in the mixture $AlBr_3$ 35, EtBr 65 wt.-%. If NaI is gradually added to an $AlBr_3\text{-EtBr}$ mixture, the electrical conductivity (κ) passes through a max. when the mol. ratio $[NaI] : [AlBr_3] = 1 : 2$; κ of the solution $NaI : AlBr_3 : EtBr = 0.135 : 0.27 : 1$ is $1.2 \times 10^{-2} \Omega^{-1} \text{ cm}^{-1}$ at 18° . From the increase of the b.p. of EtBr the calc. mol. wt. of a mixture $[NaI] : [AlBr_3] = 1 : 20$ was 239, for $[NaI] : [AlBr_3] = 1 : 2$ 345, and for $[NaI] : [AlBr_3] = 1 : 1.6$ 315. The first low val. is presumably due to electrolytic dissociation, and the third high val. to complex formation. The second val. is half of the mol. wt. of Al_2Br_6NaI ; presumably this compound is totally dissociated into Na^+ and $[Al_2Br_6I]^-$. If the $[NaI]$ is low, Al can be electrolytically deposited from the solutions as black dendrites; at high $[NaI]$ no electrodeposition occurs.
J. J. B.

Temperature-dependence of the ionisation constants of monocarboxylic acids. J. F. J. Dippy and H. O. Jenkins (*Trans. Faraday Soc.*, 1941, 37, 366—373).—Data for the variation of the ionisation consts. of monocarboxylic acids with temp. are reviewed and critically discussed. The practice of employing thermodynamic ionisation const. data for a fixed temp. and for aq. solution as a measure of true acid strength is defended.
F. L. U.

Thermodynamics of acid-base equilibria. D. H. Everett and W. F. K. Wynne-Jones (*Trans. Faraday Soc.*, 1941, 37, 373—375).—The contention of Dippy and Jenkins (preceding abstract) is criticised on the ground that inversions of acid strength with change of temp., examples of which are cited, are fairly common. A true comparison requires an exact knowledge of the various thermodynamic functions relating to ionisation.
F. L. U.

Dissociation constant of hydroxylamine. H. Hagiwara (*Bull. Inst. Phys. Chem. Res. Japan*, 1941, 20, 251—255).—The hydrolysis const. K_h of NH_2OH , determined at 25° by p_H measurements on solutions of various concn. by the glass electrode, is 1.04×10^{-6} . The dissociation const. of NH_2OH is 0.97×10^{-8} when calc. from K_h , and 0.87×10^{-8} when calc. from the distribution equilibrium of HCl between aq. NH_3 and NH_4OH .
W. R. A.

Dissociation constants of hydrazine. N. Yui (*Bull. Inst. Phys. Chem. Res. Japan*, 1941, 20, 256—263).—The dissociation consts. (K_1 and K_2) of N_2H_4 have been determined by measuring with a glass electrode at 25° the p_H variation on

amalgam-glass electrode was also used for determining the decomp. potential of an AlCl_3 -NaCl melt at 280° .

J. J. B.

Use of glass membranes for measuring the decomposition voltage of fused salts. N. G. Tschovnik and D. S. Pelkis (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, 7, 325—336, and *J. Gen. Chem. Russ.*, 1940, 10, 1443—1448).—The catholyte was inside, and the anolyte outside, a glass test-tube. Graphite electrodes were used. The decomp. voltage of PbCl_2 71.5, NaCl 28.5 mol.-% is 1.37 v. at 426° and 1.30 at 620° ; for the equimol. mixture of PbCl_2 and KCl it is 1.38 at 412° and 1.28 at 565° . These vals. are slightly < the e.m.f. of the cell $\text{Pb}|\text{PbCl}_2, \text{KCl}|\text{glass}|\text{PbCl}_2, \text{KCl}|\text{Cl}_2$ but > that of $\text{Pb}|\text{PbCl}_2, \text{KCl}|\text{Cl}_2$.

J. J. B.

Physico-chemical properties of rare metals. I. Decomposition potential of molten tantalum chloride. N. A. Belozerski and K. I. Rezvaja (*J. Appl. Chem. Russ.*, 1940, 13, 1545—1551).—The decomp. potential of TaCl_5 at 195 — 306° , in an atm. of Cl_2 , was determined, using a special apparatus, described. The heat of formation of TaCl_5 and the free energy and entropy of the process are hence derived.

R. T.

Redox potential of iodine. A. L. Rotinian and I. I. Appenin (*J. Gen. Chem. Russ.*, 1940, 10, 1524—1525).—The vals. given by Rusanova (*A.*, 1940, 1, 75) are ~ 10 mv. > the actual vals.

R. T.

Photovoltaic effects in dye solutions. B. S. V. R. Rao (*Current Sci.*, 1941, 10, 200).—Photo-potentials (E_p) for methylene-blue and Me- and malachite-green illuminated with filtered and unfiltered light from a Hg arc have been measured with a vac.-tube voltmeter. The E_p max. is at a slightly higher λ than the absorption max. in each case. The general photovoltaic behaviour of the dyes resembles that of dyes examined previously (*A.*, 1934, 740).

A. J. E. W.

Depression of maxima of polarographic curves, and displacement of the reduction potential of ions in curves connecting current density with voltage. J. P. Gochshtein (*J. Gen. Chem. Russ.*, 1940, 10, 1663—1667).—The potential of deposition of Zn or H at a Hg cathode becomes more negative in presence of Ti^+ at $p_{\text{H}} < 3$. This is associated with the electro-capillary action of Ti^+ ; the depression of the max. for Ti^+ by PO_4^{3-} or Al^{3+} is ascribed to the same cause.

R. T.

Effect of anions on reduction of nitrate ion at a dropping mercury cathode. J. P. Gochshtein (*J. Gen. Chem. Russ.*, 1940, 10, 1657—1662).—Two waves are observed in the polarographic curve obtained for KNO_3 - LaCl_3 solutions; the first wave is due to reduction of a complex ion, probably $[(\text{LaNO}_3)_2]^{3+}$, and the second to adsorption phenomena at the cathode. The height of the first wave rises with increasing concn. of added salts (KCN , $\text{Na}_2\text{S}_2\text{O}_3$, Na_2SO_4) to a certain limiting concn., above which it again falls.

R. T.

Polarographic behaviour of histidine and other amino-acids. E. R. Roberts (*Trans. Faraday Soc.*, 1941, 37, 353—357).—Polarograms of histidine (I) exhibit three characteristic waves, the heights of two of which vary linearly with $[(\text{I})]$, and one of these can be used to determine (I) in presence of arginine and lysine. Cystine, in solutions buffered with NH_4Cl and NH_3 and containing CoCl_2 , yields polarograms which are reproducible only with freshly prepared solutions. The polarographic method is not suitable for serine, tryptophan, and tyrosine.

F. L. U.

Hydrogen overvoltage at high current densities. IV. Influence of concentration, anions, temperature, and catalytic poisons. A. Hickling and F. W. Salt (*Trans. Faraday Soc.*, 1941, 37, 333—339; cf. *A.*, 1941, I, 301).—Variation of the kind of acid or its concn. does not appreciably affect H overvoltage (η) at Hg, W, or platinised Pt in the c.d. range 0.001—1 amp. per sq. cm., except when the c.d. is high enough and the concn. low enough to cause concn. polarisation. Rise of temp. to 70° causes a decrease of η with Hg and Sn corresponding with an average temp. coeff. of -0.002 v. per degree, a smaller decrease with W, and no measurable effect with Pt. Addition of As_2O_3 , HgCl_2 , or CS_2 raises η at Pt considerably and increases the slope of the η -log c.d. graph.

F. L. U.

Electrolytic deposition of a vanadium-aluminium alloy. V. A. Plotnikov and V. V. Liulka (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, 7, 399—405).—Electrolysis of mixtures of

AlBr_3 67, KBr 33 mol.-% and V_2O_5 5—12 wt.-%, using a Fe-V anode and a Cu cathode, gives at 200° and a c.d. 5—50 amp. per sq. dm. deposits consisting chiefly of VO_2 . If the electrolyte contains no V_2O_5 but Fe-V anodes are employed, from 2AlBr_3 , KBr and 2AlBr_3 , NaBr Al containing but little V is deposited, and from 2AlCl_3 , NaCl a black powder containing Al and 40% of V is obtained. The decomp. voltage of the 2AlCl_3 , NaCl melt at 233° was 2.4 v., but when a Fe-V anode was used a second kink at 2.8 v. was observed after 1 amp.-hr. had passed, obviously due to the discharge of V ions.

J. J. B.

VIII.—REACTIONS.

The Arrhenius equation and the active complex method. M. Temkin (*Acta Physicochim. U.R.S.S.*, 1940, 13, 733—746).—The active complex method is applied to the derivation of the Arrhenius equation, which is obtained in the form $d \log_e k/dT = (\epsilon_i - \epsilon_t)/kT^2$, in which ϵ_i and ϵ_t denote the average energy of active complexes and initial mols. respectively; the equation is valid for any reaction order. The same method is used to evaluate the integration const.

F. L. U.

Homogeneous isotopic interchange reaction between hydrogen and heavy alkaline solution. S. Abe (*Sci. Papers Inst. Japan, Phys. Chem. Res. Tokyo*, 1941, 38, 287—297).—The transfer of D_2 from N-KOH in D_2O to H_2 is probably due to isotopic interchange reaction taking place in the liquid phase. The rate of transfer at 100° decreases with pressure of H_2 and on pretreatment of KOH . The decrease is accompanied by an increased deposition of a flaky ppt. and the rate is immeasurable when fresh pptn. is no longer observable. The reaction is not an example of acid-base catalysis, but more probably is due to catalysis by colloidal Fe in the KOH . Pptn. of Fe as hydroxide is discussed for various experimental arrangements.

W. R. A.

Homogeneous [isotopic] interchange reaction between hydrogen and water. S. Abe (*Bull. Inst. Phys. Chem. Res. Japan*, 1941, 20, 264—276).—When H_2 reacts with N-KOH , N-HCl (both in D_2O), or D_2O at 100° in a vac. for several hr., the D content of H_2 is altered in alkaline solution and the amount of D_2 transferred is \propto vol. of solution. Different alkali preps. give quite different sp. rates. Sp. rates are (i) diminished by S or H_2S , (ii) rapidly decreased by H_2 pressure, and (iii) decreased to the extent of becoming immeasurable by pretreatment of the solution. The proposed mechanism involves catalysis by colloidal Fe (cf. preceding abstract).

Kinetics and mechanism of redox reactions. V. Oxidation of the ferrous ion by dichromate. V. F. Stefanovski (*J. Gen. Chem. Russ.*, 1940, 10, 1621—1630).—The velocity of the reaction of oxidation of FeSO_4 in acid solution by $\text{K}_2\text{Cr}_2\text{O}_7$ is expressed by $k[\text{Cr}^{VI}][\text{Fe}^{II}]^2[\text{H}^+]^2$.

R. T.

Kinetic foundations of the method of isotopic indicators. I. Kinetics of exchange reactions. S. Z. Roginski (*Acta Physicochim. U.R.S.S.*, 1941, 14, 1—26; cf. *A.*, 1941, I, 271).—Theoretical. If the isotopes may be regarded as identical in physicochemical properties, so that the condition for equilibrium is equipartition throughout all mol. species, then the kinetic equations for exchange reactions must take very simple forms even under conditions far removed from ideality. When, as in work with radioactive indicators, the concn. of the isotope undergoing exchange is very small, a further simplification is introduced, and in this case the exchange reaction will always follow a unimol. course irrespective of its mechanism, even when heterogeneous. The dependence of the unimol. velocity coeff. on initial concn. may in certain cases give information about activity coeffs. in solution, adsorption equilibria, etc.

F. J. G.

Acid hydrolysis of methyl acetate in dioxan-water mixtures. H. S. Harned and A. M. Ross, jun. (*J. Amer. Chem. Soc.*, 1941, 63, 1993—1999).—Reaction velocity coeffs. (k) of the hydrolysis of MeOAc catalysed by 0.1M- and 0.2M-HCl at 25° and 35° in aq. dioxan, containing 0—90% of dioxan, have been determined. The relative activity coeff. of MeOAc at 25° has been determined by v.p. measurements using a new technique. $k \propto [\text{HCl}]$ in all dioxan- H_2O mixtures in moderately dil. acid solution. The activation energy is approx. independent of the composition of the solvent mixture. The activity coeff. (γ^*) of the transition complex is computed from the Brönsted equation and existing data and varies

approx. similarly with the activity coefficient (γ_{HCl}) of HCl and H_2O with composition of the solvent. γ^* and γ_{HCl} , computed for KCl, NaCl, and LiCl solutions, behave similarly with composition of solution as for dioxan- H_2O mixtures and support the validity of the Brønsted equation. W. R. A.

Chemistry of macromolecules. H. W. Melville (*J.C.S.*, 1941, 414—426).—Tilden lecture. The mechanism of polymerisation and interpolymerisation reactions leading to the formation of macromols. is discussed. The methods and results of determinations of the mol. wt. of the products are described. The formation of three-dimensional polymerides is discussed. O. D. S.

Ammonolysis of halogen fatty acids and preparation of α -amino-acids.—See A., 1941, II, 243.

Kinetics of the ammonolysis of 2-chlorobenzothiazole by liquid ammonia. J. F. Lemons, R. C. Anderson, and G. W. Watt (*J. Amer. Chem. Soc.*, 1941, 63, 1953—1956).—The ammonolysis of 2-chlorobenzothiazole (I) by liquid NH_3 is a pseudo-unimol. reaction not appreciably catalysed by neutral salts or salts which are acid in liquid NH_3 . The energy of activation is $\sim 13,700$ g.-cal. per mol. The mechanism of the reaction is discussed; it appears to involve a bimol., rate-determining reaction between (I) and NH_3 . W. R. A.

Degradation of starch by β -amylase.—See A., 1941, II, 186.

Electron diffraction study of chemical reaction products of metals. Reaction between hydrochloric acid and sodium, calcium, beryllium, zinc, and aluminium. S. Yamaguchi (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, 38, 298—303).—When the reaction product is prepared as a thin film in a dry reaction the faster is the reaction velocity the larger are the crystals formed; in the wet reaction, the faster is the reaction velocity and the more hydrophilic is the compound formed the larger are the crystals. W. R. A.

Theory of thermal explosions. III. Thermal explosions in autocatalytic reactions. P. V. Melentev and O. M. Todes (*Acta Physicochim. U.R.S.S.*, 1941, 14, 27—52).—Mathematical. The theory already advanced (A., 1940, I, 28) is extended to cover the case of an autocatalytic reaction. F. J. G.

Antioxygenic effects of some nitroso-compounds. Interpretation of the effects from the point of view of resonance. Y. Tsuzuki and Y. Kimura (*Bull. Chem. Soc. Japan*, 1940, 15, 484).—The retarding effects of some NO-compounds on the autoxidation of PhCHO in air have been studied. Aliphatic compounds have little or no effect, but aromatic compounds have marked effects which for $p\text{-C}_6\text{H}_4\text{R}\cdot\text{NO}$ increase in the order ($\text{R} = \text{H} < \text{Me} < \text{Cl} < \text{Br} < \text{I}$, suggesting that the effects are due to resonance. F. J. G.

Multimolecular solvolysis: catalysis of racemisation and hydrolysis of optically active α -phenylethyl halides by polyhalide metallic salts. N. T. Farinacci (*J. Amer. Chem. Soc.*, 1941, 63, 1799—1804).—The change in α with time of solutions in which several reactions proceed simultaneously is developed theoretically. The experimental data for (i) the solvolytic methoxylation at 100° and the methoxylation by OMe at 25° of $\text{CHMeBr}\cdot\text{CO}_2\text{Me}$, and (ii) the solvolysis and racemisation of CHPhMeCl by HgCl_2 , HgCl_2^- , and EtOH are in accord with theory. The application of the theoretical considerations to other similar reaction systems is briefly discussed. W. R. A.

Simpler polypeptides. II. Kinetics of alcoholysis of polyglycine esters. S. Glasstone and E. F. Hammel, jun. (*J. Amer. Chem. Soc.*, 1941, 63, 2003—2008; cf. A., 1941, I, 167).—Kinetics of the alcoholysis of di- (I), tri- (II), tetra- (III), penta- (IV), and hexa- (V) -glycine Et esters by boiling with 99.9% EtOH catalysed by 2.0M-HCl have been investigated. The sp. rate (V) of the first stage of the reaction, which is considered to involve the splitting off of one glycine residue (cf. A., 1932, 935), increases fourfold from (I) to (II), is approx. const. for (II), (III), and (IV), and increases for (V). The increase of V from (I) to (II) is attributed to electrostatic forces. The increase of V for (V) is considered to be due to a structural change under the experimental conditions. The fission of the esters is a true alcoholysis and not a hydrolysis followed by esterification. W. R. A.

Relative ease and mechanism of conversion of *syn*-aldoxime benzoates into nitriles in presence of pyridine and pyridinium chloride.—See A., 1941, II, 256.

Catalytic action of phenols in the isomerisation of camphene hydrochloride.—See A., 1941, II, 261.

Catalytic isomerisation of Δ^a -butene. G. H. Twigg (*Proc. Roy. Soc.*, 1941, A, 178, 106—117).— Δ^a -Butene isomerises to Δ^b -butene on a Ni catalyst in presence of H_2 . By using D_2 the double bond migration has been examined simultaneously with the exchange and hydrogenation reactions. At 65° the kinetics of bond migration and of hydrogenation were identical; the reaction rates \propto the square root of the butene pressure and the H_2 pressure. The energies of activation of the three reactions were measured in the range 76 — 126° . The facts are in agreement with the theory that the catalytic exchange between olefines and D occurs through the formation of an associative complex. G. D. P.

Kinetics of the polymerisation of isoprene on sodium surfaces. J. L. Bolland (*Proc. Roy. Soc.*, 1941, A, 178, 24—42).—The reaction was studied at 60° and 25° for both liquid and vapour states. In the liquid, diffusion of the monomer to the catalytic surface is the rate-controlling factor, unless the Na surface is in the form of spheres of sufficiently small size. In the presence of PhMe the kinetics are consistent with the view that polymeric chains are initiated by formation of free radicals on the Na surface, the subsequent propagation occurring while the polymeride is still attached to the Na. Termination occurs by interaction with PhMe. In the absence of PhMe an alternative termination reaction requiring more activation energy comes into play. G. D. P.

Promoter effect of platinum chloride on Raney nickel. Hydrogenation of the nitrobenzoic acids and the nitrobenzene-aniline intermediates.—See A., 1941, II, 254.

Copper plating from ammonia bath.—See B., 1941, I, 412.

Electrolytic deposition of zinc.—See B., 1941, I, 412.

Electrolytic tin-plating of iron at high current densities with subsequent heating.—See B., 1941, I, 410.

Production of potassium permanganate. I. Anodic dissolution of ferromanganese in a diaphragm-free cell.—See B., 1941, I, 402.

Electrodeposition of nickel on iron and effect of colloids on nature of deposit.—See B., 1941, I, 410.

Volume and surface processes during the oxidation of nitrogen in a glow discharge. III. B. A. Kononova and N. I. Kobosev (*Acta Physicochim. U.R.S.S.*, 1940, 13, 193—218).—Previous investigations (cf. A., 1939, I, 619) have been extended to increased pressures (70—700 mm.). At these pressures the poisoning action of H_2O vapour decreases. This is consistent with the view that the poisoning action of H_2O vapour is a surface phenomenon which becomes relatively of less importance as the pressure increases and the reaction becomes almost wholly a vol. reaction. The poisoning action is also reduced at increased current strengths (33—150 ma.). C. R. H.

Production of sulphur monoxide by photochemical processes. A. Jakovleva and V. Kondratiev (*Acta Physicochim. U.R.S.S.*, 1940, 13, 241—246).—At pressures < 0.5 mm. the effective λ for the formation of S_2O_2 from SO_2 is < 2000 Å. If COS containing SO_2 is used, S_2O_2 is formed at $\lambda > 2260$ Å, although in absence of SO_2 no S_2O_2 is formed. From considerations of possible mechanisms and energy relations it is argued that the formation of SO is impossible under the experimental conditions and that S_2O_2 is the most probable carrier of the spectrum lines observed. C. R. H.

Chemical reactivity and light absorption. IV. N. R. Dhar, A. K. Bhattacharya, and S. P. Agarwal (*J. Indian Chem. Soc.*, 1940, 17, 675—680).—In the reactions between Cl_2 and $\text{H}_2\text{C}_2\text{O}_4$, between I and FeSO_4 , Na tartrate, HCO_2Na , $\text{NH}_4\text{OH}\cdot\text{HCl}$, COMe_2 , and $\text{N}_2\text{H}_4\cdot\text{H}_2\text{SO}_4$ respectively, between $\text{FeSO}_4\cdot(\text{NH}_4)_2\text{SO}_4$ and AgNO_3 , and between KMnO_4 and HCl the total light absorption is $>$ that of the two reactants considered separately, and the increase in light absorption increases with higher concns. of the photosensitive reducing reactant. Increased light absorption and chemical reactivity are due to the weakening of the binding forces of a mol. in presence of a photosensitive reactant. C. R. H.

Photolysis of keten and structure of methylene. M. Burton, T. W. Davis, A. Gordon, and H. A. Taylor (*J. Amer. Chem. Soc.*, 1941, 63, 1956—1960).—The photochemical decomp. of

keten by $\lambda\lambda > 3000$ Å. has been investigated at temp. from 0° to 50° and pressures 50–200 mm. in the presence of various concns. of C_2H_4 and NO. The yield of C_2H_4 is decreased when the initial partial pressure of C_2H_4 is ~ 0.33 of the total pressure but is unaffected by an equiv. concn. of NO. The primary process is $CH_2CO + h\nu \rightarrow CH_2 + CO$ and the CH_2 combines exclusively with C_2H_4 . The average ratio $CH_2CO : CO$ is 1:2 and, therefore, CH_2CO appears to react with CH_2 . CH_2 may react with NO to give the free radical CH_2NO , which is unstable and decomposes to $CH_2 + NO$, or the CH_2NO may combine with CH_2 to give $C_2H_4 + NO$. CH_2 does not behave like a free radical with NO. CH_2 has either a free radical structure or a mol. (unpromoted electron) structure with heat of formation slightly $>$ that of a free radical.

W. R. A.

Photochemistry of aqueous solution of acetamide. D. H. Volman (*J. Amer. Chem. Soc.*, 1941, **63**, 2000–2002).—The photolysis of aq. NH_2Ac has been investigated; the products are NH_3 , $AcOH$, CO_2 , CO , CH_4 , and N_2 . The quantum yield of NH_3 increases with increasing concn. and temp. The relative rates of photolysis of NH_2Ac , $EtCO\cdot NH_2$, and $PrCO\cdot NH_2$ are in the ratio 1 : 0.25 : 0.31.

W. R. A.

Theory of photosynthesis. J. Franck and K. F. Herzfeld (*J. Physical Chem.*, 1941, **45**, 978–1025).—Theories of photosynthesis hitherto published are criticised as not being in sufficient accord with facts. In a new theory which is outlined and developed mathematically the photosynthetic process is regarded as being a complicated interaction between light and dark reactions in which, in addition to chlorophyll, CO_2 , and H_2O , three different catalysts (affecting the initial process of CO_2 intake, the main photochemical process, and the liberation of O_2 from the peroxide), the acceptor mols. for CO_2 , the intermediates, and very probably proteins play a decisive rôle.

C. R. H.

Photometric determination of the rapidity of ergosterol transformation on irradiation with ultra-violet light.—See A., 1941, II, 250.

IX.—METHODS OF PREPARATION.

Thermal decomposition of alkali sulphates in presence of silica. J. A. Fialkov and S. D. Schargorodski (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, **7**, 415–428).—Alkali sulphate was mixed with SiO_2 (3 mols.) and heated for 1 hr. At 1000° 8% and at 1200° 63% of Li_2SO_4 , 3% and 20% of Na_2SO_4 , and 6% and 10% of K_2SO_4 , were decomposed. At 1100° 11% and at 1200° 12% of Rb_2SO_4 , and 8% and 13% of Cs_2SO_4 , were decomposed. The order of these % does not agree with that predicted by Nernst's theorem for the stability of the sulphates.

J. J. B.

Conditions of precipitation of calcium arsenate, and certain of its properties. M. T. Serebrennikov (*J. Appl. Chem. Russ.*, 1940, **13**, 1539–1544).—Addition of CaO to aq. Na_3AsO_4 results in production of solid solutions of CaO in $Ca_3(AsO_4)_2$, the Ca content of which rises with increase in the ratio $CaO : As_2O_5$, up to a certain limiting val. Above this, the ppt. consists of a mixture of solid solution and $Ca(OH)_2$. These effects are obtained irrespective of the initial $[As_2O_5]$ of the solution. The ppts. are insol. in H_2O when the mol. ratio $CaO : As_2O_5$ is $> 3.5-5$. Spraying tests showed that the solid solutions were not harmful to foliage.

R. T.

Recovery of mercuric iodide and iodine from nesslerised solutions. G. W. Schimpff and R. E. Pottinger (*Ind. Eng. Chem. [Anal.]*, 1941, **13**, 337–338).— HgI_2 and I are pptd. by adding H_2SO_4 and $Na_2Cr_2O_7$ to the nesslerised solution. The free I is removed by distillation (apparatus and method described). The HgI_2 is collected, washed, and dried. Both substances are then ready for use in the prep. of Nessler-Folin reagent by Koch's method.

L. S. T.

Preparation of carbon disulphide from hydrogen sulphide and hydrocarbons.—See B., 1941, II, 289.

Derivatives of monosilane. II. Iodo-compounds. H. J. Emeleus, A. G. Maddock, and C. Reid (*J.C.S.*, 1941, 353–358).—*Mono- and di-iodosilane*, SiH_3I and SiH_2I_2 , have been prepared by the interaction of dry HI and SiH_4 in the presence of AlI_3 , and fractional distillation of the product, which also contains SiH_3I and SiI_4 . SiH_3I is a colourless refractive liquid, m.p. -35.0° , b.p. $45.4^\circ/760$ mm., with a pungent odour.

It crystallises in needle and prismatic forms. The v.p. has been measured at -23.5° to 42.8° and indicates that the latent heat of vaporisation at $30-40^\circ$ is 7130 g.-cal. per g.-mol. Between 0.5° and 14.8° $d = 2.0718(1 - 0.00204\theta)$. At 15° $\sigma = 30.50$ dynes per cm., giving $[P] = 182.1$ (calc. val. 170). The vapour shows a continuous absorption in the ultra-violet region, with absorption limit in the region 2400–2520 Å. and absorption max. at < 2100 Å. SiH_2I_2 has m.p. -1° , b.p. $149.5^\circ/760$ mm. The v.p. for the temp. range $0.1-140.2^\circ$ is recorded and indicates that the latent heat of vaporisation at $83.4-93.4^\circ$ is 8050 g.-cal. per g.-mol. Between 5.1° and 20.5° $d = 2.7943(1 - 0.00320\theta)$. At 15° $\sigma = 44.1$ dynes per cm., giving $[P] = 267$ (calc. val. 250). It shows continuous absorption beginning in the region 3530–2730 Å. The action of ultra-violet light on SiH_2I_2 at 50° yields H_2 , SiH_3I , SiH_4 , SiI_4 , and another solid product, probably an iodo-di- or tri-silane. SiH_3I is also decomposed in ultra-violet light at 50° , yielding an I-free solid, probably a polymeric Si hydride, and an oil, possibly a substituted higher silane. Neither SiH_3I nor SiH_2I_2 is spontaneously inflammable in air, but they burn with reddish flames. In moist air simultaneous hydrolysis and oxidation occur. SiH_3I vapour reacts with Hg in sunlight yielding HgI , SiH_4 , Si_2H_6 , and H_2 . The liquid, in the absence of sunlight, yields a white volatile cryst. solid, possibly $HgI\cdot SiH_3$, which decomposes into HgI and SiH_4 . SiH_3I reacts slowly with Zn yielding H_2 , SiH_4 , and a liquid, probably $ZnI\cdot SiH_3$. With Mg in diisomyl ether SiH_3I yields a dark solid and the Mg dissolves, probably forming $MgI\cdot SiH_3$. Liquid SiH_3I reacts explosively with $AgCN$ yielding AgI and a brown polymeric solid, but when SiH_3I vapour is passed over $AgCN$ at room temp. silyl cyanide $SiH_3\cdot CN$, m.p. 34° , is produced. With Na SiH_3I yields Si_2H_6 . Differences in the behaviour of SiH_3I and SiH_3Cl are attributed to the great difference in bond energies of the Si-Cl and Si-I linkages.

J. W. S.

Phosphorus-halogen compounds from phosphorus pentoxide and halides. Properties of phosphorus trifluoride and phosphorus oxyfluoride. G. Tarbuton, E. P. Egan, jun., and S. G. Frary (*J. Amer. Chem. Soc.*, 1941, **63**, 1782–1789).— P_2O_5 and CaF_2 react to give POF_3 as a volatile product but other compounds appear in the volatile fraction; PF_3 is produced by reduction of POF_3 by the Fe vessel, and HPO_2F_2 is formed by partial hydrolysis of POF_3 . No PF_5 was found. In the volatile fraction from the reactions between P_2O_5 and rock phosphate or fluorapatite at 700° the principal constituent was SiF_4 , but PF_3 , POF_3 , and CO_2 were also present. With $CaCl_2$ and with $NaCl$ P_2O_5 reacts to give $POCl_3$, PCl_3 , and HCl . The wt. of $POCl_3$ was 3–10 times the wt. of PCl_3 formed. The amount of HCl \propto the amount of H_2O in the charge. No PCl_5 was found but a trace of Cl_2 was detected. The reaction between P_2O_5 and a mixture of CaF_2 and $NaCl$ has been studied at P:halogen ratios 2:3, 4:3, 5:3, and Cl:F ratios 1:1 and 3:2 at temp. between 350° and 600° . With P:halogen 2:3 the principal volatile product was POF_3 , but with the other ratios a mixture of PF_3 , POF_3 , POF_2Cl , $POFCl_2$, $POCl_3$, and HCl was formed. At temp. $> 500^\circ$ POF_3 was the constituent present in largest amount. The components of volatile mixtures were separated by fractional distillation and analysed. M.p. and b.p. are given. The v.p. of PF_3 and POF_3 can be represented, respectively, by $\log p = -861.9/T + 7.9269$ and $-1984.7/T + 11.3755$ (solid), $-1207/T + 8.0524$. The heats of sublimation, fusion, and vaporisation of POF_3 are, respectively, 9150, 3600, and 5550 g.-cal. per g.-mol.; the heat of vaporisation of PF_3 is 3950 g.-cal. per g.-mol. *Di- and triphosphoric acid*, HPO_3F_2 , has been isolated.

W. R. A.

Complex chromi-selenates. P. C. Raychoudhury (*J. Indian Chem. Soc.*, 1941, **18**, 97–102).—Evaporation of a solution of green $Cr_2(SeO_4)_3 \cdot 13H_2O$ (I) (1 mol.) with H_2SeO_4 (1 mol.) followed by drying at 120° yields the green hygroscopic *chromiselenic acid* $H[Cr(SeO_4)_2]$. Evaporation of a solution of blue $Cr_2(SeO_4)_3 \cdot 17H_2O$ (II) (1 mol.) with H_2SeO_4 (3 mols.) yields $H_3[Cr(SeO_4)_3]$ (cf. Meyer, A., 1922, ii, 70). Evaporation in a vac. of a solution containing (II) (1 mol.) and H_2CrO_4 (1, 2, or 3 mols.) yields *chromiseleni-mono-, -di-, and -trichromic acids*, $H_2[Cr_2(SeO_4)_3(CrO_4)]$, $H_3[Cr_3(SeO_4)_3(CrO_4)_2]$, and $H_4[Cr_4(SeO_4)_3(CrO_4)_3]$, respectively. All are brown and hygroscopic. If K_2CrO_4 is used instead of H_2CrO_4 the three *K chromiselenichromates* are formed. Freshly prepared cold aq. solutions of these compounds give no ppt. with aq. NH_3 or with $Ba(NO_3)_2$, but on boiling ppts. are formed. Evaporation

of aq. solutions containing green $\text{Cr}_2(\text{SO}_4)_3$ (1 mol.) and (I) (3 mols.) or $\text{Cr}_2(\text{SO}_4)_3$ (3 mols.) and (I) (1 mol.) yields the green *Cr chromi-selenatosulphate* and *-sulphatoselenate*, $\text{Cr}_2[\text{Cr}_2(\text{SeO}_4)_3(\text{SO}_4)_3]$ and $\text{Cr}_2[\text{Cr}_2(\text{SO}_4)_3(\text{SeO}_4)_3]$, respectively. Evaporation of aq. solutions containing *Cr chromichromate* (III) (1 mol.) and (I) (1 mol.) or H_2CrO_4 (3 mols.) yields the dark red *Cr chromiselenatochromate* $\text{Cr}_2[\text{Cr}_2(\text{SeO}_4)_3(\text{CrO}_4)_3]$ and chocolate *Cr chromidichromate* $\text{Cr}[\text{Cr}(\text{Cr}_2\text{O}_7)_3(\text{H}_2\text{O})_3]\cdot 3\text{H}_2\text{O}$, respectively. J. W. S.

Compounds of salts of bivalent manganese with pyridine and ethylenediamine. O. E. Zvjagintzev and M. Tschkonja (*J. Gen. Chem. Russ.*, 1940, 10, 1647—1652).—The salts $2\text{MnF}_2\cdot 2\text{NH}_4\text{F}\cdot \text{C}_6\text{H}_5\text{N}$; $5\text{MnF}_2\cdot 3\text{en}\cdot 3\text{HF}$; $\text{MnCl}_2\cdot \text{en}\cdot 2\text{HCl}\cdot \text{H}_2\text{O}$; $\text{Mn}(\text{NO}_3)_2\cdot 8\text{en}\cdot 4\text{HNO}_3\cdot 4\text{H}_2\text{O}$; $\text{MnCl}_2\cdot \text{OAc}\cdot 10\text{en}\cdot 4\text{H}_2\text{C}_2\text{O}_4$; and $\text{Mn}(\text{OAc})_2\cdot \text{en}\cdot \text{AcOH}$ are described. R. T.

Composition of Prussian and Turnbull's blues. V. Rôle of hydrolysis and their compositions. A. K. Bhattacharya (*J. Indian Chem. Soc.*, 1941, 18, 81—84; cf. A., 1941, I, 374).—The CN:Fe ratio in both Prussian and Turnbull's blue decreases with decreasing concn. of the solutions from which they are pptd., tending to vals. of 2.37 and 2.5, respectively. When pptd. by mixing ~0.125M. solutions the compounds have identical composition with CN:Fe = 2.465. J. W. S.

Ammoniates of cobalt fluoride. M. S. Litvinov (*J. Gen. Chem. Russ.*, 1940, 10, 1490—1494).—Boiling aq. $\text{Co}(\text{NH}_3)_6\text{Cl}_3$ and AgF yield $[\text{Co}(\text{NH}_3)_6]\text{F}_3$, whilst at room temp. the product is $[\text{Co}(\text{NH}_3)_6]\text{ClF}_2$, readily converted by aq. AgF at 100° into $[\text{Co}(\text{NH}_3)_6]\text{H}_2\text{O}_2\text{F}_3$. This with HF gives $[\text{Co}(\text{NH}_3)_6(\text{H}_2\text{O})_2\text{F}]\text{F}_2$, converted by H_2O at 100° into $[\text{Co}(\text{NH}_3)_6(\text{H}_2\text{O})_5]\text{F}_3$. The cobaltamine fluorides resemble the corresponding chlorides, but are in general more stable. R. T.

X.—ANALYSIS.

Tracer isotopes in analytical chemistry. J. F. Flagg and E. O. Wiig (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 341—345).—A review dealing with the prep. and separation of radioactive elements, measurement of the radiations, and applications to analysis. L. S. T.

Colorimetric determination of p_{H} in coloured or turbid solutions. J. V. Kariakin (*J. Appl. Chem. Russ.*, 1940, 13, 1713—1717).—Fixed proportions of indicator and of org. solvent are added to the solution, which is shaken, and the coloration of the non-aq. layer is compared with those of a series of standard buffer solutions similarly treated. The combinations suggested are: p_{H} 0—2.0, Me-yellow and *iso*- $\text{C}_6\text{H}_{11}\text{OH}$ (I); p_{H} 1—3, cresol-red and (I); p_{H} 3—5, thymol-blue and (I); p_{H} 4—6, bromophenol-blue and Bu^nOH ; p_{H} 6—9, bromocresol-purple and Bu^nOH ; p_{H} 8—10, rosolic acid and 1:4 (I)—EtOH; p_{H} 10—13, methylene-blue and pinene. The error is p_{H} ~0.1—0.2. R. T.

Ascorbic acid as titrimetric standard. L. Rosenthaler (*Pharm. Acta Helv.*, 1940, 15, 213—216).—Ascorbic acid is a satisfactory alkalimetric and iodometric standard. It is unsuitable for use with AgNO_3 or KMnO_4 . E. H. S.

Quantitative spectroscopic analysis of soils.—See B., 1941, III, 194.

Determination of moisture in solid materials.—See B., 1941, I, 378.

Determination of moisture in gases.—See B., 1941, I, 379.

Determination of water in benzene.—See B., 1941, II, 245.

Determination of iodine in soil waters. P. A. Smirnov (*J. Appl. Chem. Russ.*, 1940, 13, 1718—1721).—To 500 ml. of H_2O are added 1% starch solution 60, 0.5N- NaNO_3 16, 4N- H_2SO_4 10 ml., and 2 g. of $\text{CO}(\text{NH}_2)_2$. After thorough stirring 10 g. of $\text{NH}_4\text{Fe}(\text{SO}_4)_2\cdot 12\text{H}_2\text{O}$ are added, followed by NaHCO_3 to complete pptn. of Fe. The ppt. of $\text{Fe}(\text{OH})_3$ with co-pptd. starch and adsorbed I, is collected on the centrifuge, and the process is repeated with the centrifugate. A solution in 4N- H_2SO_4 of the combined ppts. is distilled for 20 min., and the I collecting in the receiver is titrated with 0.2N- $\text{Na}_2\text{S}_2\text{O}_3$. An empirical correction of 1 mg. is added to the result. R. T.

Determination of iodate ion in presence of cupric ion. P. L. Kapur and M. R. Verma (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 338).—Mixtures of KIO_3 and CuSO_4 can be titrated with

$\text{Na}_2\text{S}_2\text{O}_3$ (starch) after an excess of $\text{Na}_4\text{P}_2\text{O}_7$, AcOH, and KI have been added in this order. The Cu complex formed with $\text{P}_2\text{O}_7^{4-}$ is stable under the conditions given. Liberation of I from the KIO_3 and KI is slow, and several likely catalysts, e.g., NH_4 molybdate, failed to speed up the reaction. L. S. T.

[Determination of] fluorine. P. A. Clifford (*J. Assoc. Off. Agric. Chem.*, 1941, 24, 350—363).—The "positive perchlorate error" observed in Willard and Winter's method (A., 1933, 242) can be reduced to <1 μg . F per 150 ml. of distillate by using all-glass apparatus and avoiding superheating of the sides of the flask. The remaining error is due to F, presumably from the glass of the still. H_2SO_4 is more effective than HClO_4 as a distilling acid, but recovery is incomplete even if >150 c.c. are collected. The cause of the retention of F is unknown, but fuming the still with H_2SO_4 increases recovery. Methods are detailed. The indicator preferred is *p*- $\text{NO}_2\cdot\text{C}_6\text{H}_4\cdot\text{OH}\cdot\text{EtOH}$, and a little $\text{NH}_4\text{OH}\cdot\text{HCl}$ is used to discharge traces of Cl when HClO_4 is employed. Porcelain contributes small quantities of F to ash. Filtration through glass filters avoids possible contamination with HF from treated filter-paper. A. A. E.

Determination of sulphur in sulphur-bearing ores by combustion in a current of oxygen.—See B., 1941, I, 412.

Detection of nitrates and nitrites by means of amidol (2:4-diaminophenol hydrochloride). M. V. Darbinian (*J. Appl. Chem. Russ.*, 1940, 13, 1745—1746).—A 1% solution of amidol in dil. HCl is added to the solution under test; a red coloration appears in presence of <5 mg. NO_2 per l. When 1% amidol in conc. H_2SO_4 is added carefully to the solution, a red ring forms above the H_2SO_4 layer in presence of <50 mg. NO_3 per l. R. T.

Determination of ammoniacal and nitrate-nitrogen in decomposed plant material.—See A., 1941, III, 713.

Perchloric acid oxidation of organic phosphorus in lake waters. R. J. Robinson (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 465—466).—The H_2O , acidified with HClO_4 , is evaporated and the P determined colorimetrically as PO_4^{3-} using Denigès' method. Results comparable with those found using $\text{H}_2\text{SO}_4\text{--HNO}_3$ for oxidation are obtained, but the procedure is simpler. J. D. R.

Analysis of sodium meta-, pyro-, and ortho-phosphates. A. B. Gerber and F. T. Miles (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 406—412).—The method described previously (A., 1938, I, 582) is applied to the analysis of Na phosphates, and compared with other methods of analysis. It determines the amounts of P_2O_5 associated with 1, 2, or 3 Na_2O or H_2O , which are reported as meta-, pyro-, and ortho-phosphate, respectively, but does not distinguish between a polyphosphate and a mixture of equiv. amounts of meta- and pyrophosphate. Sources of discrepancies in using various methods of phosphate analysis are discussed. In methods where phosphate radicals are determined by pptn. with metallic ions consideration cannot be limited, as is common, to meta-, pyro-, and ortho-phosphates, but must be extended to the phosphate complexes or polyphosphates. L. S. T.

Determination of arsenic in foods contaminated by war gases.—See B., 1941, III, 211.

Rapid determination of arsenic in foodstuffs contaminated with lewisite.—See B., 1941, III, 211.

Determination of boron by means of quinalizarin. P. W. Maunsell (*New Zealand J. Sci. Tech.*, 1940, 22, B, 100—111).—A solution (1 c.c.) containing B (~0.002 mg.) was treated with 99.4% H_2SO_4 (9 c.c.) and quinalizarin (0.5 c.c.; 0.01 g. in 88.6% H_2SO_4) and set aside overnight over H_2SO_4 , and the red colour (mixed with blue) determined by comparison with a standard. The colour changes rapidly at first but reaches a const. val. after some hr. (cf. Smith, A., 1936, 42); rise in temp. does not affect the development of the colour. A slight increase in $[\text{H}_2\text{SO}_4]$ diminishes the amount of the red component, and vice versa. Atm. H_2O does not affect the colour development until the v.p. is 7.5 mm. of H_2O . Org. matter bleaches the blue colour but does not affect the red. C introduces neutral tints. A small excess of quinalizarin increases the red and blue components in the same ratio. When the B content is >0.004 mg., the accuracy of the method is greatly reduced. The method is applied to the determination of B in soils and plants. J. L. D.

Determination of carbon monoxide in combustion gases by means of iodine pentoxide.—See B., 1941, I, 388.

Evolution-volumetric method for [determining combined] carbon dioxide [in soaps].—See B., 1941, II, 310.

Application of electrotitration to analysis of soap.—See B., 1941, II, 310.

Rapid determination of potassium with hexanitrodiphenylamine (dipicrylamine). H. Sueda and M. Kaneko (*Bull. Chem. Soc. Japan*, 1941, 16, 137—139).—The ppt. after washing is dissolved in COME₂ and the solution directly titrated with standard acid, the end-point being indicated by the resulting colour change. The method is rapid and accurate to ~1%. F. L. U.

Qualitative analysis for cations, without the use of hydrogen sulphide. I. P. Vilgusevitch (*J. Appl. Chem. Russ.*, 1940, 13, 1747—1754).—An analytical procedure is proposed. R. T.

Detection of silver by means of ammonium persulphate and manganese sulphate. P. G. Popov (*J. Gen. Chem. Russ.*, 1940, 10, 1442).—5 ml. of 0.016% MnSO₄ in N-H₂SO₄ are added to 5 ml. of solution, the mixture is heated to 100°, 0.1 g. of (NH₄)₂S₂O₈ is added, and the coloration developing after 4 min. is compared with that given by a blank test. A rose-violet colour appears in presence of < 5 µg. Ag. R. T.

Titration of oxalate [and of calcium].—See A., 1941, II, 236.

Determination of blood-magnesium.—See A., 1941, III, 730.

Determination of zinc by precipitation as zinc anthranilate. Gravimetric semi-micro-method. C. W. Anderson (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 367—368).—Details of procedure for the determination of Zn as anthranilate in Zn-Sn alloys, enamel coatings, white metal alloys, and ZnCl₂ fluxes, and typical results obtained, are recorded. Small amounts of Zn⁺⁺ are separated from large amounts of Fe⁺⁺⁺ by a modified basic acetate method. L. S. T.

Determination of small amounts of zinc in plant materials: dithizone method.—See A., 1941, III, 713.

[Determination of] copper. C. A. Greenleaf (*J. Assoc. Off. Agric. Chem.*, 1941, 24, 337—348).—Procedure and collaborative data for the determination of Cu in presence of Ni, Co, Zn, Sn, and Bi in a sample simulating spinach ash, (a) by separation with H₂S in presence of Pb⁺⁺ as gatherer, and (b) by extraction with dithizone, followed by colorimetric determination with NEt₃-CS₂-Na (I), are recorded. There was considerable variation in the quantity of Bi extracted in (b). In absence of Bi, Co, and Ni, the (I) method may be applied directly to a solution obtained by wet combustion or ashing. A. A. E.

Determination and separation of copper with benzotriazole. J. A. Curtiss (*Ind. Eng. Chem.*, 1941, 13, 349—351).—Benzotriazole (I) ppts. Cu⁺⁺, Fe⁺⁺, Ag⁺, Ni⁺⁺, Cd⁺⁺, Zn⁺⁺, and Co⁺⁺ from ammoniacal tartrate-OAc⁻ solutions. Pptn. of Cu is complete only between p_H 7.0 and 8.5. In absence of these ions, Cu⁺⁺ can be pptd. directly and, after drying for 2—3 hr. at 135—140°, weighed as (C₆H₄N₃)₂Cu. 45 ml. of 2% aq. (I) are required to ppt. 0.01 g. of Cu⁺⁺, and 50 ml. for 0.018 g. of Cu⁺⁺, which is the max. amount of Cu⁺⁺ permissible for rapid and convenient handling of the voluminous ppt. 0.0002 g. of Cu⁺⁺ in 200 ml. of solution can be determined. Digestion times of 5 or 30 min. at 25° or 100° are equally effective in pptg. the Cu. In presence of the above ions, (I) is used for preliminary separation of Cu⁺⁺. The ppt. is then ignited to oxide, and the Cu⁺⁺ determined by a standard method, generally by means of KI and Na₂S₂O₃. (I) can be used in this way for the determination of Cu in cast Fe and steels; details of procedure are given. Advantages over pptn. of Cu as CuS are that an oxidising attack can be used, a clean separation from Mo^{VI}, Se^{IV}, Te^{IV}, Sb^V, and As^V is obtained, and ignition of the ppt. is more rapid, with less danger of fusion, than that of CuS. Separation of Cu by (I) is not practicable in presence of large amounts of Ni, Co, Ag, Cd, and Zn. Besides the group 11b metals mentioned above, Fe⁺⁺⁺, Sb⁺⁺⁺, Sn⁺⁺⁺, Cr⁺⁺⁺, CrO₄⁺⁺, and Al⁺⁺⁺ are not pptd. by (I) in ammoniacal tartrate-OAc⁻ solution. L. S. T.

Bromo-complexes for identification of metals and alkaloids. E. P. White (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 509—511).—Conditions for the use of bromo-metallic salts of alkaloids,

sparingly sol. in bromide solution, as micro-analytical tests for Hg, Cd, Bi, Sb, Pb, and Sn, or as tests for alkaloids of certain *tert.* types are described. Such salts are often cryst. and characteristic in appearance, and photomicrographs of many are reproduced. Likely sources of interference are discussed and concn. limits are given for different alkaloids and metals. Mixtures have not been studied. A scheme for the systematic identification of certain alkaloids is presented. J. D. R.

Fractional detection of aluminium. I. M. Korenman (*J. Appl. Chem. Russ.*, 1940, 13, 1722—1723).—NH₄Cl and excess of aq. NH₃ are added to the solution, which is then boiled, and the ppt. is collected and washed with aq. NH₄Cl-NH₃, and then with conc. aq. NH₃. NH₄Cl and alizarin-red are added to the aq. NH₃ washings, and the solution is boiled. A rose-red coloration is obtained in presence of < 0.1 mg. Al. Other cations and anions do not interfere. R. T.

Use of silicomolybdic acid indicator before volumetric oxidation of iron. A. C. Titus and C. W. Sill (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 416—418).—In the method detailed and illustrated by test data, silicomolybdic acid indicator, which is reduced to Mo-blue by SnCl₂, replaces HgCl₂, since the blue colour disappears just before oxidation of Fe⁺⁺ begins. The vol. of standard K₂Cr₂O₇ used between this "blue end-point" and the appearance of the red colour of N-phenylanthranilic acid indicator is equiv. to the Fe being determined. The method is accurate to 1 in 1000. L. S. T.

Iodometric determination of ferric iron in presence of organic material. R. G. Parchomenko (*J. Appl. Chem. Russ.*, 1940, 13, 1740—1744).—KI is added to the solution, which should contain 2 mols. of HCl per Fe⁺⁺⁺, and the I liberated is titrated. A no. of org. substances (mannitol, tartaric acid, glycerol, sucrose, glucose, soil extracts) do not interfere. R. T.

Determination of neutral salt contents of chrome [tanning] liquors by conductometric analysis.—See B., 1941, II, 285.

Semi-quantitative determination of small amounts of tin, using "anthrazo-reagent" (1-p-dimethylaminobenzeneazoanthraquinone). V. I. Kuznetsov and I. M. Bender (*J. Appl. Chem. Russ.*, 1940, 13, 1724—1731).—A drop of solution is placed on paper impregnated with aq. 1-p-dimethylaminobenzeneazoanthraquinone hydrochloride; a blue stain appears in presence of 0.01—0.05 mg. Sn^{IV} per ml. of solution. The intensity of coloration is compared with those given by a series of standard Sn^{IV} solutions. Certain cations interfere when their concns. are > the following: Zn, U, Mo I, Cd 0.5, Al 25 mg. per ml., whilst Sb and Te do not interfere when present as Sb^V and Te^{IV}. Nb interferes only when tartaric acid is present. R. T.

XI.—APPARATUS ETC.

M.p. apparatus. A. Yaussy and C. C. Kiplinger (*Science*, 1941, 93, 166).—In the apparatus described a triple-wall air-bath minimises heat losses and eliminates inflammable or corrosive bath liquids, the thermometer is enclosed entirely, no stirrer is required, and the thermometer bulb and melting capillary are partly surrounded by Hg. L. S. T.

Graphite heating baths. W. I. Harber (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 429).—The flask is placed on a layer of powdered graphite (I) in a slightly larger Fe container, and then surrounded and tightly packed with (I). Heating is done by means of a Bunsen or Meker burner. Fire risk is eliminated, and distillations can be carried out at high temp. L. S. T.

Thyratron-controlled annealing furnace. L. Tarnopol (*Rev. Sci. Instr.*, 1941, 12, 367—368).—A temp. control circuit and a furnace are described and figured. The furnace may be used at temp. > 1000°, and the circuit will give continuous precision control better than ±0.03° for any long period required, e.g., several weeks, even if the supply fluctuates over a range of from 90 to 130 v. A. A. E.

Theory of thermal explosions. IV. Study of the loss of heat in closed vessels for the purpose of determining the explosion constants. O. M. Todes and B. N. Karandin (*Acta Physicochim. U.R.S.S.*, 1941, 14, 53—70).—When convection plays a part in the transfer of heat from a reacting gas to the walls of the vessel, purely mathematical treatment fails. Accordingly, the cooling of a hot gas has been studied experimentally, and an empirical equation connecting functions of

various parameters (size of vessel, conductivity, viscosity, etc.) is given. F. J. G.

Flame temperature. B. Lewis and G. von Elbe (*J. Appl. Physics*, 1940, **11**, 698—706).—Methods of determining flame temp. are reviewed. The theoretical flame temp., corresponding with complete statistical equilibrium in the burned gas, is distinguished from the experimental flame temp. measured by the gas law equation, and corresponding with equilibrium in the translational degrees of freedom. The two temp. can be compared by explosion experiments. For monat. gases, mixed with H_2 and O_2 and exploded, the experimental and theoretical temp. are identical, but for diat. gases the experimental temp. are $>$ the theoretical. This is due to excitation lag in the internal degrees of freedom. The theory and technique of the line reversal method are described. The method gives the experimental flame temp. The determination of flame temp. by wires and thermocouples, and by the measurement of brightness and absorptivity in the infra-red, are discussed. The luminous, soot-forming flame has a temp. corresponding with the theoretical. The temp. difference between the soot particles and the surrounding gas is negligible. Methods of determining the temp. and emissivity of such flames are described. A. J. M.

Refractive index of matter in a cylindrical form. A. H. Pfund (*J. Opt. Soc. Amer.*, 1940, **30**, 410—412).—A simple method of determining the refractive index, n , of liquids is described. The apparatus consists of two coaxial cylindrical lenses formed either by a glass rod immersed in a test-tube containing the liquid under test, or by a tube containing the test liquid immersed in a larger vessel containing a standard liquid. An inclined wire is observed through the lens system and the slope of the central part of the image is measured. n may be determined with an accuracy of a few parts per thousand. The refractometer has no upper limit and may be used for liquids with any val. of n . O. D. S.

Cell for optical diffusion measurements on solutions. H. Neurath (*Science*, 1941, **93**, 431—432).—A diffusion cell of small vol., designed on the principle of the new Tiselius electrophoresis cell, is described and illustrated. It is suitable for diffusion measurements with solutions of proteins as well as of substances of low mol. wt. L. S. T.

Modified photon reflectometer for use with test-tubes. R. L. Libby (*Science*, 1941, **93**, 459—460). L. S. T.

Spectrophotometry of [light of] low intensity. A. A. Schischlovski (*Physical Trans. Ukrain. Acad. Sci.*, 1940, **9**, 19—27).—A new spectrophotometer which utilises 40% of the light energy as compared with 6% in the Koenig-Martens apparatus is described. J. J. B.

Rotary compensators with a very large measuring range. A. Ehrlinghaus (*Z. Krist.*, 1939, **102**, 85—111).—A modified form of a previous instrument (A., 1938, I, 417), consisting of two 10-mm. quartz plates, has a measuring range of 70 λ_D , or 198 λ_D with extra plates, with an accuracy of 0.7%. Its size demands a special microscope stand and an objective of very wide aperture. A second compensator of moderate size (range 133 λ_D , accuracy 0.1%) consists of two 1-mm. calcite plates. The relation between compensation and dispersion of double refraction, and the determination of the point of compensation in the absence of dark fringes, are considered in detail. A. J. E. W.

Rotating differential photo-electric photometer for precision work. J. T. MacGregor-Morris and A. G. Stainsby (*Proc. Physical Soc.*, 1941, **53**, 584—594).—Methods of photometry using rectifier type Se cells are discussed. The design and performance are described for a new instrument in which two cells in opposition are rotated. Fluctuations of ~ 1 sec. can be studied photometrically, and the candle power ratio of two sources of the same colour can be determined in a few sec. to within 1 in 500. N. M. B.

Thermoelectric effects in photometry. J. K. Berry (*Ind. Eng. Chem. [Anal.]*, 1941, **13**, 396—397).—Errors due to such effects and their elimination are discussed. L. S. T.

Photo-electric apparatus for detection of methane.—See B., 1941, II, 245.

Photo-electric temperature control. A. D. Compton, jun. (*Science*, 1941, **93**, 215—216).—In the arrangement described the advantages of a thyatron tube are used more fully by employing the phase-shift method of control, and by eliminat-

ing the make-and-break contact of a Hg-PhMe thermo-regulator. The column of Hg in this regulator interrupts a focussed beam of light, and the rise or fall of the Hg decreases or increases the amount of light falling on a photo-tube, and this, in turn, controls the amount of current flowing through the heating unit. The bath temp. is controlled thus to $\pm 0.001^\circ$ for 48 hr. L. S. T.

Photon theory of optical resolving power. B. P. Ramsay, E. L. Cleveland, and O. T. Koppius (*J. Opt. Soc. Amer.*, 1941, **31**, 296—300).—Arguments are presented for the existence of an inverse dependence of resolving power on the magnitude of the intensity observed in an optical system. L. J. J.

Electron lens type of β -ray spectrometer. C. M. Witcher (*Physical Rev.*, 1941, [ii], **60**, 32—42).—The instrument utilises the focussing action of the homogeneous magnetic field of a long solenoid. Theory of the action for a point source of β -rays and extension to an actual source of finite area are discussed, and design and tests of the instrument are described. Data for the β -ray spectra of Ra-E, ^{32}P , and ^{137}I are reported. The forms of the distribution curves agree better with the Fermi than with the Konopinski-Uhlenbeck theory. N. M. B.

Production, properties, and applications to micro-analysis of arcs possessing large-area anode spots. E. W. Foster (*Proc. Physical Soc.*, 1941, **53**, 594—613).—Factors influencing the area of hot spots are discussed. Experiments are described in which an arc is struck in air at atm. pressure between a graphite cathode and a graphite anode in the form of a cup at the end of a thin pillar. The cup is filled with powdered graphite impregnated with one of several alkali and alkaline-earth salts. At first a localised spot appears at each electrode, but after a time t_s the anode spot extends rapidly over the powder surface. This stable condition is maintained for a period t_b usually $> t_s$ until the salt is exhausted. t_s and t_b depend on the amount and nature of the salt, on the anode dimensions, and on the arc current. The relation between t_s and t_b and the other variables is shown graphically and a theory is proposed. A satisfactory general spectrographic system of quant. microchemical analysis for mineral matter is suggested and discussed. N. M. B.

Electronic relay. R. C. Hawes (*Science*, 1941, **93**, 24).—An improved relay for heat control is described (cf. A., 1940, I, 420). L. S. T.

Electronic relay for heat control. A. C. Hall and L. J. Heidt (*Science*, 1940, **92**, 612).—A method for avoiding chattering in the relay described previously (A., 1940, I, 420) is given. L. S. T.

Vacuum tube time-delay relay. E. J. Serfass (*Ind. Eng. Chem. [Anal.]*, 1941, **13**, 352—353).—The relay described is constructed from standard radio replacement parts. It can be operated from a.c. or d.c. power supply. L. S. T.

A.c.-powered p_n set. C. W. Goodwin (*Science*, 1940, **92**, 587—588).—An a.c.-powered current amplifier that has a high input impedance and does not fluctuate spontaneously is described for measurement of p_n . L. S. T.

Saturated calomel electrode. M. G. Banus (*Science*, 1941, **93**, 601—602).—The electrode described and illustrated avoids disturbance of the interfaces and contamination of the saturated KCl. It is especially suitable for electrometric titrations of acid-base or oxidation-reduction potentials. L. S. T.

Sintered-glass salt bridge. H. A. Laitinen (*Ind. Eng. Chem. [Anal.]*, 1941, **13**, 393).—The construction of a \perp -shaped salt bridge from Pyrex glass with sintered glass at the two feet is described. The bridge has a low electrical resistance, and eliminates siphon action. L. S. T.

Indicator electrodes made of mixtures of electrolytically conducting salts. E. M. Skobetz and G. A. Kleibs (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, **7**, 299—309, and *J. Gen. Chem. Russ.*, 1940, **10**, 1612—1620).—Electrodes were prepared by closing an end of a glass tube with a molten and solidified mixture of AgI with AgBr or Ag_2S ; the salt mixture was fixed to the glass with picein. The tube was filled with a KCl or $AgNO_3$ solution, and a $Ag|AgCl$ electrode inserted. The resistance of AgI-AgBr and AgI- Ag_2S mixtures is so small that the e.m.f. of the cells $Ag|AgCl|aq. KCl$ or $AgNO_3|salt mixture|an aq. solution|saturated Hg_2Cl_2 electrode$ can be determined using a galvanometer as the null-point de-

tector. The arrangement was tested for the titration of AgNO_3 with KBr , KI , or KCNS , for the titration of KI with AgNO_3 , etc. Mixtures of 1 part of AgI and 1 part of AgBr , and of 9 parts of AgI and 1 part of Ag_2S , are recommended. J. J. B.

Electrical bombardment of biological materials. II. Electron tube for the production of homogeneous beams of cathode rays from 10 to 100 kv. O. Morningstar, R. D. Evans, and C. P. Haskins (*Rev. Sci. Instr.*, 1941, 12, 358—362).—Apparatus for the irradiation of a target area of 36 sq. in. with electron beams of intensity 10^{-6} — 10^{-10} coulomb per sq. cm. and of energy 10—100 kv. is described and figured. The beam can be easily adjusted and scanned for homogeneity. A. A. E.

Insulated vacuum leads. D. F. Bleil and C. D. Hause (*Rev. Sci. Instr.*, 1941, 12, 369—370).—An insulated, vacuum-tight, and readily replaceable filament assembly for an all-metal gaseous magnetron is described and figured. The W filament, of any desired length, is attached to the W supports by winding fine Fe wire around the two and melting the Fe with a spot welder. A. A. E.

Electron microscope. H. E. Rhea (*Science*, 1941, 93, 357—358).—The instrument described works on a normal 110-v. power line, and is simple to operate. With it 150 photographs of prepared specimens can be taken in a day. L. S. T.

Quartz fibre balance. O. H. Lowry (*J. Biol. Chem.*, 1941, 140, 183—189).—A hollow quartz fibre, 20 cm. long, is mounted nearly horizontally with the free end 12—15 cm. above the fixed end, and placed in an air-tight metal cylinder with a glass lid. The object to be weighed is hung on the free end and the movement read with a cathetometer. The balance has a sensitivity of 0.03 μg . with a capacity of 200 μg . D. F. R.

Distilling column head. P. Arthur and C. L. Nickolls (*Ind. Eng. Chem.*, [Anal.], 1941, 13, 356—357).—A column head for use in the prep. of spectroscopically pure org. liquids is described and illustrated. L. S. T.

Arrangement for fractional distillation at low temperature.—See B., 1941, I, 378.

Apparatus for pressure filtration. E. A. Brown and N. Benotti (*Science*, 1941, 93, 23—24).—The apparatus described permits sterilisation of protein solutions by rapid and foamless Seitz filtration. L. S. T.

Apparatus for producing constant gas mixtures. R. A. Lewis and G. F. Koepf (*Science*, 1941, 93, 407—408).—Apparatus for making const. mixtures of atm. air and N_2 is described. Data illustrating performance are given. Const. composition is obtained despite fluctuations in rate of flow. L. S. T.

Glass stopcocks. M. Shepherd (*Nat. Bur. Stand.*, 1941, 9, Circ. 430, 10 pp.).—A discussion, embracing the design, construction, grinding, lubrication, and care of stopcocks, with particular reference to high-vac. technique. Examples are given of specially designed stopcocks, having multi-bore keys, which replace a no. of simple stopcocks, and thus considerably reduce the no. of operations in routine gas sampling and analysis. D. F. R.

Pressure-regulating apparatus for vacuum systems. F. M. Lewis (*Ind. Eng. Chem.* [Anal.], 1941, 13, 418).—Two types of apparatus which will maintain a desired pressure within ± 0.2 mm. in the range 5—100 mm. are described and illustrated. L. S. T.

Method of measuring contact angles. J. J. Bikerman (*Ind. Eng. Chem.* [Anal.], 1941, 13, 443—444).—The method described is based on the measurement of the ratio Δ_0^3/v , where Δ_0 is the diameter of the basis of the drop and v the vol. L. S. T.

S.I.L. viscosimeter. E. L. Ruh, R. W. Walker, and E. W. Dean (*Ind. Eng. Chem.* [Anal.], 1941, 13, 346—349).—Construction and operation of a glass viscosimeter of the long-capillary type are described. The apparatus has been used successfully in routine tests. L. S. T.

Laboratory circulating pump. H. M. Woodburn (*Ind. Eng. Chem.* [Anal.], 1941, 13, 356).—A centrifugal stirrer of Pyrex

tubing rotated in a closed, flat, circular tin can is described. It gives a pumping rate of 1.3 l. per min. through a horizontal line and 0.65 l. per min. when H_2O is lifted 60 cm. L. S. T.

Automatic speed control for the air-driven ultracentrifuge. A. Rothen (*Rev. Sci. Instr.*, 1941, 12, 355—358).—By means of an automatic optical device, based on a stroboscopic principle, the speed of the centrifuge can be maintained const. to <1 r.p. sec. A. A. E.

Continuous water remover. J. H. Thelin (*Ind. Eng. Chem.* [Anal.], 1941, 13, 405).—Apparatus for removing H_2O formed in org. reactions is described and illustrated. L. S. T.

Apparatus for detection of sulphur dioxide [in air].—See B., 1941, III, 220.

Apparatus for detection of carbon monoxide in mines.—See B., 1941, III, 220.

Comparison of methods for sampling lead fume.—See B., 1941, III, 246.

Automatic carbon disulphide recorder.—See B., 1941, III, 246.

Simple automatic indication of dangerous concentrations of hydrogen cyanide in air.—See B., 1941, III, 246.

XII.—LECTURE EXPERIMENTS AND HISTORICAL.

Newer views of Priestley and Lavoisier. (Sir) P. J. Hartog (*Ann. Sci.*, 1941, 5, 1—56).

XIII.—GEOCHEMISTRY.

Nitrogen in rain water. P. A. Roelofsens (*Natuurwetensch. Tijds. Ned.-Indië*, 1941, 101, 179—180).—The rainfall and N content of the rain (average 1.5 mg. per l.) for the years 1925—1940 at the Deli Experimental Station (Medan) are recorded. In 1939, 13% of the total N was present as NH_3 . The origin of this N and its relationship with the N content of the Deli river H_2O are discussed. S. C.

Isotopic composition of atmospheric precipitations. S. G. Demidenko (*Acta Physicochim. U.R.S.S.*, 1940, 13, 305—311).—Investigation of the isotopic composition of snow, ice, and rain formed under a variety of conditions has shown that snow and hoar-frost have a low D and a normal ^{18}O content, whereas moisture and rain have a normal isotopic composition, although a few rain samples showed an increased ^{18}O content. C. R. H.

Hydrothermal formation of clay minerals in the laboratory. II. F. H. Norton (*Amer. Min.*, 1941, 26, 1—17).—An extension of previous work (A., 1939, I, 345) in which reactions have been carried out on similar materials, but at higher pressures of CO_2 and H_2O vapour. The rate of conversion of albite is greatest at 300° and ~ 300 lb. per sq. in. initial pressure of CO_2 . At pressures > 500 lb. per sq. in., there is no conversion into the end-product, which may be montmorillonite (I) or beidellite (II) (cf. *loc. cit.*). The conversion curve of nephelinite into sericite (III) is large in area, but has well-defined limits of temp. and CO_2 -pressure. The reaction area for orthoclase is limited, and at high pressure there is no conversion into (III). The relative amounts of kaolinite (IV) and dickite (V) obtained from spodumene under different conditions are tabulated; (V) predominates at the lower temp., and (IV) at the higher. The conversion contours are not closed completely at high pressures. With anorthite, the end-product is not pyrophyllite (cf. *loc. cit.*) but (I) or (II). At 300° and 500 lb. per sq. in., leucite and scolecite give (III), lepidolite gives a slight conversion into quartz, beryl, pollucite, and (IV) are unchanged, analcite gives (IV), quartz, and (V). Minerals containing the largest % of alkali are the least stable. For some of the above minerals, the rate of conversion by stronger acids (dil. HCl , H_2SO_4 , and HF) is $<$ that with CO_2 . In all reactions, the end-products are similar to, but not identical in every respect with, the natural clay minerals. L. S. T.

Periods of coal formation represented in the British Coal Measures. A. E. Trueman (*Geol. Mag.*, 1941, 78, 71—76).—The zonal distribution of the more important coal in various coalfields is discussed in relation to periods of coal formation. L. S. T.

A., I.—General, Physical, and Inorganic Chemistry

NOVEMBER, 1941.

I.—SUB-ATOMICS.

Spectra of Cd IV, In V, and Sn VI in the isoelectric sequence Rb I to Sn VI. M. Green (*Physical Rev.*, 1941, [ii], 60, 117—121; cf. Gilbert, A., 1935, 1292).—The spectra were photographed in the region 270—1800 Å. with a 3-m. normal-incidence vac. spectrograph, and a highly condensed high-voltage vac. spark light source. Data and classifications are tabulated for 185 lines of Cd IV, 43 of In V, and 39 of Sn VI, with assignment of 51 term vals. for Cd IV, 32 for In V, and 25 for Sn VI. The irregular doublet law and the law of const. second difference were applied in the classification of many of the lines. The separation of the $4d^9 2D$ multiplet of the ground state was found for each of the three ions. Most of the odd terms arising from the $4d^8 5p$ electron configuration and some of the even terms arising from the $4d^8 5s$ configuration were determined. N. M. B.

Hyperfine structure of osmium lines. T. Kawada (*Proc. phys.-math. Soc. Japan*, 1938, [iii], 20, 653—655; *Chem. Zentr.*, 1938, ii, 3891).—Measurements with glass and quartz Lummer plates give the following displacement vals. ($\times 10^{-3}$ cm.⁻¹) and relative intensities, respectively, for components of the lines specified: 4420.64 Å. ($d^6 s^2 5D_4 - d^6 sp^7 D_4$); *a*, -98, 15; *b*, 0, 100; *c*, 66, 53; *d*, 128, 41; *e*, 189, weak; *f*, 258, 23; 4261.01 Å. ($d^6 s^2 5D_4 - d^6 sp^7 D_4$); *a*, -207, 16; *b*, 0, 100; *c*, 66, 52; *d*, 131, 32; *f*, 327, 22; 4135.95 Å. ($d^6 s^2 5D_4 - d^6 sp^7 P_4$); *a*, -126; *b*, 0; *c*, 59; *d*, 105; *f*, 218 (no intensities). The *b*, *c*, and *d* components are attributed to ¹⁸²Os, ¹⁹⁰Os, and ¹⁸⁶Os, respectively; the displacements occur in the $d^6 s^2 5D_4$ level. The lighter isotopes give the deepest levels, as in Hg, Pt, and W. The *a* and *f* components are ascribed to ¹⁸⁹Os (spin $\frac{1}{2}$), and the *e* component of the 4420 Å. line to ¹⁸⁶Os. A. J. E. W.

Recombination law for weak ionisation [in atmospheric air]. P. J. Nolan (*Nature*, 1941, 148, 26).—Experiments have been carried out on air free from nuclei to test the implications of a previously proposed equilibrium equation (cf. A., 1940, I, 425). L. S. T.

"Shot effect" in temperature-limited diodes. M. Surdin (*Nature*, 1941, 148, 27).—The classical formula of the shot effect is derived by following Bernamont's method for the Johnson effect. L. S. T.

Effect of light in gases under electrical discharge. S. S. Joshi and G. S. Deshmukh (*Nature*, 1941, 147, 806).—The instantaneous diminution of the discharge current in Cl₂ on irradiation reported previously (A., 1941, I, 151) has been extended to other gases subjected to ionisation by collision in electric fields due to alternating potentials in Siemens tubes. The photo-variation of the discharge current diminishes rapidly in the order Cl₂, Br₂, NCl, and I₂. The effect has also been observed in O₂, air, N₂, and H₂, but is \ll in the halogens. The effects of changes in conditions are described. L. S. T.

Nuclear magnetic moments of ¹³C, ¹³⁵Ba, and ¹³⁷Ba. R. H. Hay (*Physical Rev.*, 1941, [ii], 60, 75—86; cf. A., 1940, I, 382).—From measurements of *g* vals. by the mol. beam magnetic resonance method and determinations of the signs of the nuclear magnetic moments μ , vals. of μ (in nuclear magnetons) were found with the help of nuclear spins *I*. For ¹³C the *g* val. is 1.402 ± 0.004 and the moment is positive. This, with the results of theoretical treatment of the ¹³C nucleus, indicates $I = \frac{1}{2}$, giving $\mu = 0.701 \pm 0.002$. For ¹³⁵Ba and ¹³⁷Ba the moments are positive, the *g* vals. are 0.5575 ± 0.0017 and 0.6236 ± 0.0019 , and with $I = \frac{1}{2}$ for both nuclei, the vals. 393

of μ are 0.8363 ± 0.0026 and 0.9354 ± 0.0029 , respectively, and the ratio of the moments is 1.1174 ± 0.0010 . All *g* vals. are referred to the val. 2.1688 for ⁷Li. For Ba only two resonance min. were found. N. M. B.

Precision measurement of nuclear magnetic moments by the molecular beam magnetic resonance method. Moments of ¹H, ⁷Li, ¹⁹F, and ²³Na. S. Millman and P. Kusch (*Physical Rev.*, 1941, [ii], 60, 91—100).—A direct comparison of nuclear magnetic moments with the electronic moment was made by the measurement of the Larmor precession frequency of the nucleus and the frequencies of some of the lines of the radio-frequency spectra of the alkali atoms in the same magnetic field. The magnetic moment of the proton is found to be 2.7896 ± 0.0008 nuclear magnetons. The corr. vals. are ⁷Li 3.2532, ¹⁹F 2.625, and ²³Na 2.215, and the corr. *g* val. for ⁷Li is 2.1688 ± 0.0010 . From these results re-calc. *g* vals. and magnetic moments for 18 other nuclei are tabulated. N. M. B.

Electronic *g* factors for alkali atoms. M. Phillips (*Physical Rev.*, 1941, [ii], 60, 100—101; cf. preceding abstract).—An investigation of possible theoretical deviations from $g_s = 2$ for the ground state of the alkalis indicates that none is large enough to affect measurably the experimental results. N. M. B.

Residual current of an ionisation chamber and the true conductivity of dielectric liquids. A. Rogozinski (*Physical Rev.*, 1941, [ii], 60, 148—149).—A method is described for determining residual current due to phenomena inside an ionisation chamber which are essential for cosmic-ray intensity measurements. In a chamber containing a dielectric liquid the residual current can be practically identified with the true conductivity of the liquid; in the case of liquid hexane it is only 1/6 of the total current. The method described allows a decision as to whether the true conductivity of the liquid tends to zero with continued purification, or whether the liquid behaves, with respect to ionising radiations, as a high-pressure gas. N. M. B.

Isotopic constitution of lead and the measurement of geological time. III. A. O. Nier, R. W. Thompson, and B. F. Murphey (*Physical Rev.*, 1941, [ii], 60, 112—116; cf. A., 1939, I, 169).—Mass-spectrographic measurement of the relative abundances of the isotopes Ra-G, Ac-D, and Th-D, in 13 samples of common Pb and in 8 samples of radiogenic Pb (from different localities), 5 of which originated from minerals containing U and Th, afforded three independent determinations of the age. The age of the oldest sample (from Manitoba monazite) appears to be nearly 2×10^9 years. Full data are tabulated. N. M. B.

Production of electron pairs. J. C. Jaeger (*Nature*, 1941, 148, 86; cf. A., 1936, 400).—The vals. of the cross-section per atom for absorption by pair production by γ -rays of energy $5mc^2$ for the at. nos. 82 and 54 are tabulated with the vals. calc. on the Born approximation. L. S. T.

γ -Ray transition of radio-bromine. R. E. Siday (*Proc. Roy. Soc.*, 1941, A, 178, 189—201).—The cloud chamber was used to investigate the γ -rays emitted in the disintegration of the metastable radio-Br, ⁸⁰Br. The principal γ -ray has an energy of 47 kv. and a coeff. of internal conversion in the *K* shell of 0.43. A weaker component of 37 kv. energy was also observed. G. D. P.

Precise measurement of the energies of β -rays from radium (B + C). A. F. A. Harper and N. F. Roberts (*Proc. Roy. Soc.*, 1941, A, 178, 170—189).—Measurements were carried out on 11 lines of the β -ray spectrum of Ra-B and on one

line of Ra-C, two different types of magnetic spectrograph being used. The results, accurate to 1 part in 10^4 , confirm those of Rogers (cf. A., 1937, I, 275). A source of error, due to scattering of electrons in the photographic emulsion, which produces a change of shape of the line is thought to be the most important factor limiting the accuracy obtainable by the method.

G. D. P.

Helium repulsive potential from collision cross-section measurements. I. Amdur and H. Pearlman (*J. Chem. Physics*, 1941, 9, 503—506; cf. A., 1940, I, 89).—Total collision cross-sections for fast (300—1000 e.v.) He atoms, scattered in He at room temp., have been measured. The val. of the repulsive intermol. potential necessary to produce the observed variation of cross-section with voltage is discussed. J. W. S.

Induced radioactivity of krypton and xenon. E. P. Clancy (*Physical Rev.*, 1941, [ii], 60, 87—90; cf. A., 1940, I, 340).—Irradiation of Kr with 11-Me.v. deuterons produces 102 min., 4.0 hr., and ~35 hr. activities. Se bombarded with 22-Me.v. α -particles gives Kr activities of 114 min. and ~33 hr. The 114-min. period coincides with that assigned to ^{83}Kr growing out of ^{83}Br (cf. Langsdorf, *ibid.*, 141). The 102-min. period is similarly assigned and is probably formed by a (d, p) or (d, d) reaction. The 4-hr. activity is attributed to ^{87}Kr , and the weak 33—35-hr. activity to ^{79}Kr or ^{81}Kr . Irradiation of Xe with deuterons produces activities of 68 min. and 9.6 hr., assigned to ^{137}Xe and ^{135}Xe , respectively, and a 5.4-day activity which also appears in the irradiation of Te with α -particles and is due to ^{135}Xe . N. M. B.

Effect of temperature on the secondary electron emission of nickel. (Miss) M. Healea and (Miss) C. Houtermans (*Physical Rev.*, 1941, [ii], 60, 154; cf. A., 1941, I, 1).—The effect was studied for Ni bombarded with 1000-e.v. He^+ ions from ~900° through the Curie point to ~room temp. No change > random variations of ~1% was found. This accords with the results of Wooldridge (cf. A., 1940, I, 404) for 160-e.v. electrons as bombarding particles. N. M. B.

Artificial radioactivity of ^{45}Ti . J. S. V. Allen, M. L. Pool, J. D. Kurbatov, and L. L. Quill (*Physical Rev.*, 1941, [ii], 60, 155).—A strong radioactive positron period of 3.08 hr. was produced by proton and by deuteron bombardment of Sc, and is assigned to ^{45}Ti according to the reactions $^{45}\text{Sc}(p, n)^{45}\text{Ti}$ and $^{45}\text{Sc}(d, 2n)^{45}\text{Ti}$. N. M. B.

Fission yield by fast neutrons. M. Ageno, E. Amaldi, D. Bocciarelli, B. N. Cacciapuoti, and G. C. Trabacchi (*Physical Rev.*, 1941, [ii], 60, 67—75; cf. Roberts *et al.*, A., 1939, I, 234, Ladenburg *et al.*, *ibid.*, 504).—Measurements of the fission cross-section σ of U for neutrons from the D + D, D + Be, and D + B reactions indicate that σ has a nearly const. val. σ_1 between 1 and 10 Me.v.; for neutrons from the Rn + Be and D + C reactions σ is $\sim \frac{1}{2}\sigma_1$ and $\frac{1}{3}\sigma_1$, respectively, and for D + Li neutrons $\sigma = 1.40\sigma_1$. This last-named was attributed by Bohr (cf. A., 1941, I, 144) to successive transformations possible for energies of the impinging neutrons > 10 Me.v. A similar increase of σ was observed for Th, in good agreement with theory. N. M. B.

Total and scattering cross-sections for slow neutrons. M. D. Whitaker and W. C. Bright (*Physical Rev.*, 1941, [ii], 60, 155).—Experiments are described and data reported for the total, scattering, and capture cross-sections of C, Pb, CS_2 , Fe, Ni, Cu, and Mn for slow neutrons. N. M. B.

Uranium fission with Li-D neutrons: energy distribution of the fission fragments. K. Lark-Horovitz and R. E. Schreiber (*Physical Rev.*, 1941, [ii], 60, 156).—Using U sputtered on Al foil and U_3O_8 deposited on a brass disc, fission with slow neutrons gives results agreeing with available data; both types of targets show two peaks (with single particles) at 64 and 95 Me.v. On filtering out the slow neutrons, there appeared, in addition, a peak at 86 Me.v., assigned to symmetrical fission, and peaks at 52 and 110 Me.v. apparently corresponding with highly asymmetrical fission. About 5% of the total no. of tracks gave a peak at 130—135 Me.v. believed to be due to a new type of ternary or triple fission, and 0.5% at 145 Me.v. Results are confirmed by using the thin foil and observing the total ionisation. With slow neutrons the main peak is at 164, and with fast neutrons at 172 Me.v., with indications of fragments at 190—200 Me.v. The energy distribution confirms the process of symmetrical fission corresponding with chemical evidence (cf. Segrè, A., 1941, I, 314). N. M. B.

Mechanism of the sodium coulometer. J. Steigman (*Physical Rev.*, 1941, [ii], 60, 157).— NaNO_3 was bombarded with slow neutrons, an electric light bulb was then dipped in the molten salt, and an electrolysis current run for 1 hr. With a Geiger-Müller counter the activity of the Na deposited inside the bulb was 0.2% of that of the NaNO_3 . This supports the mechanism proposed by Burt (cf. A., 1925, ii, 921) that the Na ions on the inside of the glass are neutralised and vaporised as metal and that Na ions from the fused salt replace those of the glass, the process being one of replacement rather than of diffusion (cf. Zworykin, A., 1926, 1032). N. M. B.

Chemistry of atomic nuclei. F. Körösy (*J. Hung. Chem. Soc.*, 1941, 2, No. 5, 1—8).—A summary of laws, rules, and experimental methods, and a description of the high-voltage apparatus used. E. A.

Chemistry of energetic atoms produced by neutron capture. W. F. Libby (*Science*, 1941, 93, 283—285).—A discussion. Retention of induced radioactivity occurs mainly in the target substance. Dilution with a solvent no atoms of which are near the active atom in mass results in zero limiting retention. Retention in the gaseous state is \ll in the liquid or solid state, but is not necessarily zero at zero pressure. L. S. T.

Photographic method of estimating the mass of the mesotron. D. M. Bose and (Miss) B. Choudhuri (*Nature*, 1941, 148, 259—260).—A statistical method of estimating the mass of the particles described previously (cf. A., 1941, I, 145) is detailed. The results confirm the previous view that the tracks are due to secondary mesotron showers produced chiefly by cosmic-ray neutrons. L. S. T.

Effect of temperature on cosmic radiation. F. X. Roser (*Ann. Acad. Brasil. Sci.*, 1941, 13, 145—158).—The variation of the intensity of cosmic radiation is due to the combined effect of the diurnal and the annual meteorological changes. F. R. G.

Thundercloud as a source of penetrating particles. E. C. Halliday (*Physical Rev.*, 1941, [ii], 60, 101—106).—Observations of 65 thunderstorms and 5000 cloud-chamber photographs of electron tracks with 4500 control photographs were made. A statistical examination of the relative no. of penetrating electron tracks in the two sets of photographs indicates a strong possibility that penetrating electrons are ejected from thunderclouds and reach the earth at considerable distances from the clouds. The experiments indicate that the hypothesis that the ejected electrons travel in helical paths about the earth's magnetic field is untenable. N. M. B.

Azimuthal variations of cosmic radiation for 60° zenith angle at 22° latitude. P. S. Gill (*Physical Rev.*, 1941, [ii], 60, 153; cf. Hutner, A., 1939, I, 296).—A preliminary report of experiments to find the predicted azimuthal variation at a fixed zenith angle. Directional asymmetries are shown by the curves for the no. of counts at various azimuthal angles. The asymmetry is $0.1 \pm 0.8\%$ for true magnetic N. and S. N. M. B.

Proper lifetime of mesotrons. J. Barnóthy and M. Forró (*Physical Rev.*, 1941, [ii], 60, 154).—Experiments with a two-fold coincidence counter to determine the average path length before decay, and thus the proper lifetime τ_0 of mesotrons, are described. Assuming that the mesotrons are generated mainly at a height corresponding with 8 cm. Hg pressure and have a rest energy $E_0 = 7 \times 10^7$ e.v., calculations are given leading to the val. $\tau_0 = 1.6 \times 10^{-8}$ sec., in good accord with available data. N. M. B.

Interaction of mesotrons and nuclei. J. R. Oppenheimer and J. Schwinger (*Physical Rev.*, 1941, [ii], 60, 150—152).—Difficulties arising from a development of the formalism of mesotron field theories in analogy with the method of classical electrodynamics or with the perturbation technique of quantum electrodynamics led to the Heisenberg-Bhabha treatment of the mesotron equations and the Bhabha-Heitler theory of proton isobars. In order to amplify the conclusions of Wentzel, based on the connexion of these two sets of ideas, an investigation is made of nuclear forces and the small scattering, zero spin, and highly multiple production of mesotrons in cosmic rays. Heisenberg's treatment is, in part, generalised, and the classical problem of the coupling of neutral and charged, scalar and pseudo-scalar mesotrons to an extended spatially fixed source is considered. Wentzel's quantum problem of the charged scalar field is treated, with

an extended source instead of a lattice space, in the limit where the coupling const. is large, and, analogously, for the neutral pseudo-scalar in the corresponding limit. N. M. B.

Finite self-energies in radiation theory. I. A. Landé (*Physical Rev.*, 1941, [ii], **60**, 121—127).—Mathematical. The Fourier terms in the expression for the energy in Fermi's classical radiation theory are modified by consideration of the energy reduction factor, due to radiative damping, of an electric particle vibrating in a field. Hence the Dirac finite radius r_0 due to the damping term in the equation of motion of the electric particle now occurs in a modified Coulomb energy expression and the finite self-energy of a single particle becomes $e^2/2r_0 = 0.75mc^2$. N. M. B.

Bose-Einstein statistics and degeneracy. D. S. Kothari and B. N. Singh (*Proc. Roy. Soc.*, 1941, **A**, **178**, 135—152).—The thermodynamic properties of degenerate and non-degenerate Bose-Einstein gas in the completely non-relativistic and relativistic cases are derived. The relativistic degenerate case corresponds with black body radiation. The possibility of the existence of non-degenerate radiation is discussed. G. D. P.

II.—MOLECULAR STRUCTURE.

Properties of the free radical CS. V. Kondratyev and E. Magaziner (*J. Phys. Chem. Russ.*, 1940, **14**, 6—9).—CS was produced by discharge in vapour of CS₂ or of S and paraffin oil, and detected by its absorption bands. The absorption decayed within t min. CS₂ and O₂ up to 100° and 30 mm. Hg did not affect t . It strongly depended on the state of the walls of the vessel, and was, e.g., raised by rinsing the vessel with H₂O and lowered by rinsing with aq. H₃PO₄. At room temp. t was ~10 min. and at 100° 3 min. On the walls a brown powder (polymeric CS?) was deposited. J. J. B.

Absorption spectrum of gaseous azoimide. J. M. Tolmatshev (*J. Phys. Chem. Russ.*, 1940, **14**, 10—15).—HN₃ shows two series of diffuse bands. One consists of 8 bands between 3260 and 2812 Å., each ~30 Å. wide. The other has 15 bands between 2304 and 2016 Å., each ~12 Å. wide. There is also a continuous absorption. No conclusion as to the structure of HN₃ can be reached from these results. J. J. B.

Infra-red absorption spectrum of propane. (Miss) V. L. Wu and E. F. Barker (*J. Chem. Physics*, 1941, **9**, 487—491).—The absorption spectrum of C₃H₈ has been examined in the λ region 1.35—35 μ . The bands fall into three symmetry classes, designated A₁, B₁, and B₂, distinguishable by their characteristic contours. By analogy with the corresponding frequencies in C₂H₆, C₂H₄, and cyclopropane probable assignments of the bands are made. J. W. S.

Spectroscopic studies of the simpler porphyrins. III. Absorption spectra of *ms*-tetraphenylporphine and a series of its metal complex salts. V. M. Albers and H. V. Knorr (*J. Chem. Physics*, 1941, **9**, 497—502; cf. A., 1936, 1048; 1941, **I**, 238).—Absorption curves and mol. absorption coeffs. of *ms*-tetraphenylporphine and its Cu, Ag, Mg, Zn, Cd, Hg, SnCl₂, Pb, MnCl, FeCl, Co, and Ni complex salts are reported for the visible spectral range. Variations in the spectra of the salts are \gg for other *ms*-tetrasubstituted porphines studied. J. W. S.

Dispersion spectra of crystalline and amorphous benzo-phenone. M. Vuks (*Acta Physicochim. U.R.S.S.*, 1940, **13**, 31—42).—A method of obtaining single crystals of the labile modification (m.p. 23.5°) of C₆H₅ is described. Raman spectra for the two cryst. modifications, for the liquid, and for vitreous C₆H₅ at -52° are recorded. In the region $\Delta\nu < 150$ cm.⁻¹ the spectra of the two cryst. modifications are different, and the lines of the stable modification shift to lower $\Delta\nu$ as the temp. rises to the m.p. (46°). Evidently the spectrum in this region depends on the lattice structure. The melts of the two modifications give the same Raman spectrum, and apart from a slight shift towards higher $\Delta\nu$, there is no change of this when the liquid is cooled into the vitreous state. F. J. G.

Spectral investigation of chemical processes in organic compounds at low temperatures. II. A. Terenin (*Acta Physicochim. U.R.S.S.*, 1940, **13**, 1—30).—The study of the behaviour of org. compounds in thin films at -180° under ultra-violet excitation (A., 1941, **I**, 72) has been continued.

NH₂Ph in radiation of λ 3100—4000 Å. gives a violet luminescence having a max. at 3300 Å., i.e., slightly shifted towards longer λ as compared with the fluorescence of the vapour. This luminescence increases gradually to a max. during excitation, and afterwards persists for a time, decreasing in intensity according to a hyperbolic law. In radiation of shorter λ (2000—2200 Å.) the violet glow soon changes to a green fluorescence, which is due to phenazine, formed by photocondensation of two adjacent mols. of NH₂Ph, with liberation of H₂. The violet afterglow extends beyond the original zone of excitation. As the absence of free electrons is shown by the absence of photoconductivity, there are two alternative explanations: either excitation by recombination of migrating H atoms, or direct migration of electronic excitation energy (an "exciton") in the lattice. In presence of NH₃ (which affords H atoms in light of ~2000 Å.), an enhancement of the afterglow occurs, as would be expected on the former hypothesis, but NH₃ does not produce any afterglow in dibenzyl. MeCHO gives a blue luminescence having a continuous spectrum and decaying exponentially. C₁₀H₈ gives a deep violet fluorescence, i.e., its fluorescence spectrum is shifted towards the visible. In light of $\lambda < 3000$ Å. and in presence of CCl₄ this fluorescence changes to an intense white fluorescence, and after evaporation of the CCl₄ a yellow-green fluorescence appears the spectrum of which is identical with the "hauptspektrum" of C₁₀H₈. Possible interpretations of this spectrum are discussed. F. J. G.

Spectral investigation of chemical processes in organic compounds at low temperatures. II. Correction. A. Terenin (*Acta Physicochim. U.R.S.S.*, 1941, **14**, 566—567).—With improved apparatus the spreading of the afterglow of NH₂Ph previously reported (see preceding abstract) is not observed. F. L. U.

Spectrochemical researches on xanthates. I. Alkyl xanthates and ethylthioxanthate. II. By-products of xanthation and viscose. K. Atsuki and T. Takata (*J. Soc. Chem. Ind. Japan*, 1940, **43**, 394—397B, 397—400B).—I. The first and second absorption bands (1/ λ) of the compounds RO-CS-SNa are: R = Me 3350, 2650, Et 3350, 2600, Pr, Bu, and CH₂Ph 3300, 2600, and amyl 3350, 2590. They show no third band, this being characteristic of RS-CS-SNa, the other bands of which are 2100—3150 and 2400; the former is considered to be due to the >C:S radical since RO-CS-SNa has the bands 3300—3350 and 2600—2650. Replacement of Na by K has little effect but Co, Bi, and VO^{III} produce considerable differences.

II. Vals. obtained for by-products of xanthation and viscose (I) indicate that (I) contains both >C:S and SNa:C:S, which are responsible for its first and second bands (3360 and 2600—2650), respectively, and that (I) is a pure compound in an alkaline medium and has the constitution (cellulose:O)CS-SNa, which is the result of replacing the alkyl radical of an alkylxanthate by cellulose. The second band disappears when (I) is hydrolysed. J. G.

Absorption of light by chlorophyll solutions. G. Mackinney (*J. Biol. Chem.*, 1941, **140**, 315—322).—The absorption coeffs. (k_a , k_b) of chlorophyll *a* and *b* in MeOH (99.8%), Et₂O (containing 2—3% of EtOH), and 80% aq. COMe₂ have been determined and compared with published vals. in anhyd. Et₂O and COMe₂. At 6600 Å. k_a in the impure Et₂O is ~4% > and at 4720 Å. is ~20% < k_a in anhyd. Et₂O. The determination of chlorophyll *a* and *b* in *Avena* and *Malva* extracts by the suitable application of simultaneous equations derived from absorption data in aq. COMe₂ of chlorophyll *a* and *b* separately is illustrated. C. R. H.

Absorption spectra of haemoglobin in solution and in red blood corpuscles. D. Keilin and E. F. Hartree (*Nature*, 1941, **148**, 75—77).—Experiments are recorded confirming and extending results of previous workers, viz., that the strong Soret or γ -band in the absorption spectrum of haemoglobin and oxy-, CO-, and met-haemoglobin in solutions is barely perceptible or completely invisible in these pigments within intact corpuscles. This failure to observe the γ -band is due to an optical effect brought into play by the properties of surfaces separating haemoglobin from the surrounding medium. L. S. T.

Quenching and depolarisation of resonance radiation by collisions with molecules of a foreign gas. A. Ellett, L. O. Olsen, and R. Petersen (*Physical Rev.*, 1941, [ii], **60**, 107—111).—A semi-classical theory is presented. The total de-

polarising probability is divided into two parts to allow for adiabatic and non-adiabatic depolarisation. The equations for polarisation are generalised to apply to observed polarisation results from several lines of a hyperfine group, and the effect of a magnetic field applied along the direction of observation is included in the treatment. Experimental results on the polarisation of the Hg line $\lambda 2537 \text{ \AA}$. as a function of pressures of H_2 , D_2 , N_2 , and O_2 and as a function of magnetic field at various const. gas pressures show good agreement with the theory. Calc. cross-sections for quenching and depolarisation are tabulated. N. M. B.

Spectral character of reflexion by a regularly stratified medium. R. V. Subrahmanian (*Proc. Indian Acad. Sci.*, 1941, 13, A, 467—482).—The intensity and spectral character of the light reflected from a regularly stratified medium are calc. by standard electromagnetic theory methods. For small vals. of the reflecting power, there is a sharply defined primary band of selectively reflected λ , accompanied by secondary bands of diminishing intensity on the longer- λ side. The effect of variation in the reflecting power, thickness, and no. of laminae is discussed. L. J. J.

Luminescence, absorption, and scattering of light in diamonds. I. Fluorescence. II. Phosphorescence. P. G. N. Nayar (*Proc. Indian Acad. Sci.*, 1941, 13, A, 483—497, 534—542).—I. All λ $< 4156 \text{ \AA}$. excite a sharp band at 4156 \AA , discrete, rather diffuse bands at 4278, 4387, 4514, and 4643 \AA , and a feeble superimposed continuous spectrum to 6300 \AA , in all crystals of diamond. The intensity of the fluorescence in different crystals examined varied by a factor $\sim 10^4$. The fluorescence spectrum brightens and disappears as the exciting λ is made equal to and then $> 4156 \text{ \AA}$. The effect is ascribed to the degree of structural perfection of the crystal. Between -180° and 200° , the bands broaden unsymmetrically and shift towards longer λ with increasing temp. At higher temp. the fluorescence disappears.

II. After illumination is cut off, the same series of bands as that found in fluorescence is emitted, with a continuous region 5050 — 6300 \AA . The intensities in the discrete and continuous regions are of the same order. Only the discrete system is regarded as true fluorescence. The phosphorescence requires ~ 1 min. for its full excitation and several min. for decay. At $\sim -180^\circ$ the phosphorescence disappears in a few sec., but is again emitted when the temp. is raised. At high temp. phosphorescence is brighter and more persistent. $\lambda > 4156 \text{ \AA}$. excite a low-intensity spectrum identical with that of phosphorescence. λ slightly $> 4156 \text{ \AA}$. excite fluorescent 4156 \AA . L. J. J.

Raman effect in relation to crystal structure: lattice oscillations. S. Bhagavantam (*Proc. Indian Acad. Sci.*, 1941, 13, A, 543—563).—Both low- and high-frequency Raman lines of crystals are representatives of the various optical series of normal oscillations of crystal lattices. Formulae applying to internal, rotatory external, and translatory external oscillations are developed. Translatory oscillations especially in org. crystals and others of low m.p. are characterised by weak Raman lines of low frequency. Rotatory oscillations have large frequencies and give strong Raman lines if the rotating group is optically anisotropic. L. J. J.

Intensities of the Raman lines in carbon dioxide. N. S. N. Nath and E. V. Chalam (*Proc. Indian Acad. Sci.*, 1941, 13, A, 339—351).—The polarisability of a mol. is assumed to consist of the bond polarisabilities as functions of the inter-nuclear distances. Certain normal co-ordinates can be quadratic functions of some of the variations in the inter-nuclear distances and this accounts for the appearance of overtone Raman lines. The ideas have been applied to CO_2 . W. R. A.

Depolarisation of light scattered by liquids. K. S. Bai (*Proc. Indian Acad. Sci.*, 1941, 13, A, 439—460).—The depolarisation (ρ) of scattered light, for different slit-widths of a spectrograph of high dispersion and resolving power, has been investigated for tetralin, HCO_2H , AcOH , $\text{Pr}^i\text{CO}_2\text{H}$, PhNO_2 , Et lactate, C_6H_6 , $\text{C}_6\text{H}_5\text{Cl}$, CHBr_3 , $(\text{CH}_2\text{OH})_2$, cyclohexanol, CHCl_3 , Et_2O , EtOH , MeOAc , COMe , and CCl_4 at different temp. ρ for the unmodified line corresponding with the limiting slit-width is finite for all these liquids. The "wing" in liquids starts with max. intensity at the Rayleigh line and falls off exponentially with increasing wave-no. shift. A theoretical treatment is developed which explains the observed effect of temp. on the intensity distribution in the "wing." W. R. A.

Photo-electric efficiency of ferromagnetic metals at different temperatures in the soft X-ray region. S. R. Rao and K. S. S. Iyer (*Proc. Indian Acad. Sci.*, 1941, 13, A, 411—438).—The photo-electric sensitivities of Fe, Co, Ni, and Cu for soft X-rays have been investigated from 30° to 950° . For Fe the sensitivity is const. up to 780° and thereafter decreases $\sim 10\%$ up to 900° , beyond which it increases. It appears therefore that the transition from α -Fe to β -Fe is accompanied by a change in the photo-electric threshold. Vals. for Co and Ni are unaffected by temp. and no change in photo-electric threshold is evidenced in transitions from one crystal form to another or at the Curie point of Ni. The photo-electric effect due to soft X-rays more closely resembles the effect with ultra-violet radiation than the effect produced by hard X-rays. W. R. A.

Rectification in discharge tubes. II. V. T. Chiplonkar (*Proc. Indian Acad. Sci.*, 1941, 13, A, 323—338; cf. *ibid.*, 1939, 10, 381).—The pressure variation of the rectification ratio in discharge tubes, with air, H_2 , and N_2 , has been studied as a function of the relative sizes of the electrodes and the interelectrode distance. The rectification ratio is dependent on the nature of the gas. The curves for air and N_2 are similar but differ greatly from that for H_2 . W. R. A.

Effect of admixture of silver on rectifying properties of Cu-Cu₂O cells. K. R. Dixit (*Proc. Indian Acad. Sci.*, 1941, 13, A, 498—503).—Admixture of Ag with Cu in Cu-Cu₂O barrier-layer rectifiers gives max. rectification with 7.5% Ag in the case of layers formed at 800° , and 6% Ag for layers formed at 850° . L. J. J.

Effect of flow on the dielectric constant of liquids. S. P. Prasad, B. N. Singh, and B. D. Singh (*Nature*, 1941, 147, 712).—When flowing through condenser plates of small separation, xylene (a mixture of *o*-, *m*-, and *p*-), Et_2O , EtOH , and C_6H_6 show small, but distinct, decreases in the vals. of ϵ . For a given separation, the charge increases in magnitude with increase of rate of flow. Polar as well as non-polar liquids show the effect, but a viscous liquid, e.g., $\text{C}_5\text{H}_{11}\text{OH}$, shows it to a much smaller extent. L. S. T.

Dipole moments of some nitro- and amino-derivatives of benzene and naphthalene. V. Vassiliev and J. Sirkin (*Acta Physicochim. U.R.S.S.*, 1941, 14, 414—416).—Vals. of $\mu \times 10^{18}$, in C_6H_5 and dioxan, respectively, are recorded as follows: PhNO_2 , 4.01, 4.03; NH_2Ph , 1.54, 1.77; $\text{o-NO}_2\text{-C}_6\text{H}_4\text{NH}_2$, 4.26, —; $\text{p-NO}_2\text{-C}_6\text{H}_4\text{NH}_2$, 6.17, 6.81; 2:3:1, —, 7.30, 2:4:1, —, 6.48, 2:5:1, —, 2.67, 2:6:1, 1.88, —, 3:4:1, —, 8.90, and 3:5:1-(NO_2)₂ $\text{C}_6\text{H}_3\text{NH}_2$, —, 5.91; 2:4:6:1-(NO_2)₂ $\text{C}_6\text{H}_3\text{NH}_2$, —, 3.25; 1:2:4, —, 7.11, and 1:3:5- $\text{NO}_2\text{-C}_6\text{H}_3(\text{NH}_2)_2$, —, 5.86; 3:1:4- $\text{NO}_2\text{-C}_6\text{H}_3\text{Me-NH}_2$, 4.37, —; 2:4:1- $\text{NO}_2\text{-C}_6\text{H}_3\text{Cl-NH}_2$, 4.41, —; 2:4:1- $\text{NO}_2\text{-C}_6\text{H}_3\text{I-NH}_2$, 4.55, —; 1- $\text{C}_{10}\text{H}_7\text{NO}_2$, 3.98, —; 2- $\text{C}_{10}\text{H}_7\text{NO}_2$, 4.36, —; 1:8- $\text{C}_{10}\text{H}_6(\text{NO}_2)_2$, 7.22, —; α - $\text{C}_{10}\text{H}_7\text{NH}_2$, 1.49, —; β - $\text{C}_{10}\text{H}_7\text{NH}_2$, 1.77, 2.10; 2:1, 4.89 at 40° , —; 3:1, 5.14, —; 4:1, —, 6.97, 5:1, 5.22, —, 8:1, 3.12, —; 1:2, 4.47 at 40° , —; 4:2, 4.62, —; 5:2, 5.03, —, 6:2, —, 7.10, and 8:2- $\text{NO}_2\text{-C}_{10}\text{H}_6\text{NH}_2$, 4.47, —; 2:4:1, —, 5.60, 2:5:1, —, 5.05, and 1:6:2- $\text{NO}_2\text{-C}_{10}\text{H}_5\text{Br-NH}_2$, —, 5.13; 1-, 3.98, —, and 2-nitrotetralin, 4.81, —. All vals. are at 25° unless otherwise indicated. Deviations from vector additivity of the moments of polar groups are attributed to the influence of resonance structures, and the sp. effect of dioxan on the moments of NH_2 -compounds to the formation of a complex (having a H-bond) with dioxan. F. J. G.

Statistical mechanics of fusion. J. G. Kirkwood and (Miss) E. Monroe (*J. Chem. Physics*, 1941, 9, 514—526).—Mathematical. The theory is based on the use of local free energies. The entropy and vol. changes of A during fusion are calc. from the theory and are considered to be in adequate agreement with experiment, especially at 1 atm. pressure. J. W. S.

Self-consistent field for methane and its applications. R. A. Buckingham, H. S. W. Massey, and S. R. Tibbs (*Proc. Roy. Soc.*, 1941, A, 178, 119—134).—An approximation is obtained by averaging the proton distribution over all orientations so as to get a spherically symmetrical nuclear field. The eight-electron problem is then solved. The wave functions are used to calculate the charge distribution, energy, diamagnetic susceptibility, and polarisability of the mol. and also the van der Waals force between two mols. The scattering of slow electrons by the field is also investigated, the observed

similarity in the behaviour of A and CH_4 being reproduced by the theory. Comparison with observation shows that the theory for CH_4 is not less satisfactory than similar calculations for atoms. G. D. P.

Force constants of carbon-carbon bonds. J. W. Linnett (*Trans. Faraday Soc.*, 1941, 37, 469—473).—By the application of a force field analogous to that used for C_2H_6 , Me halides, and MeCN (cf. A., 1940, I, 99) the fundamental frequencies of CH_3CMe and CMe_2CMe are calc. The length of the C—C single bond in CMe_2CMe is ~ 1.47 Å. or slightly larger. The vals. given by Crawford and Brinkley (A., 1941, I, 101) for the force const. for these two compounds are too small; more satisfactory vals. are 5.5 and 5.3×10^5 dynes per cm., respectively. F. L. U.

Chemical bond in hard compounds. I. A. Brager (*Acta Physicochim. U.R.S.S.*, 1941, 14, 297—306).—Published vals. of a for TiC, TiN, TiO, VC, VN, and VO are compared, and the most reliable vals. selected as follows: TiC, 4.320 Å; TiN, 4.235; TiO, 4.16; VC, 4.23; VN, 4.129; VO, 4.08 Å. For each metal, a is a linear function of the at. radius of the non-metal, indicating covalent linkings, and moreover vals. of a for isoelectronic substances are closely similar, and decrease linearly with increase in the no. of electrons available per bond. On the other hand small differences between the experimental vals. of a and those calc. from the at. radii indicate some ionic character of the linkage, increasing from Ti to V and from C through N to O in analogous compounds, and from V to Ti in isoelectronic compounds. F. J. G.

Structure of boron hydrides. J. Sirkin and M. Diatkina (*Acta Physicochim. U.R.S.S.*, 1941, 14, 547—561).—The proposed structure for B_2H_6 contains a B^- ion bonded with 4 H atoms and a B^+ ion bonded with 2 H atoms; in the actual mol. resonance occurs between this and a corresponding structure with the signs reversed. Somewhat similar structures are suggested for the remaining hydrides; all of them contain bivalent B^+ and quadrivalent B^- ions. F. L. U.

Magnetism and molecular structure of sulphur compounds. S. S. Dharmatti (*Proc. Indian Acad. Sci.*, 1941, 13, A, 359—370).—The diamagnetic susceptibilities of S_2Cl_2 , S_2I_2 , SCl_2 , SOCl_2 , SO_2Cl_2 , and ClSO_3H have been calc. according to the methods of Slater and Angus and compared with experimental vals. The vals. for various valency states of S have been calc. W. R. A.

Effect of dislocations on magnetisation near saturation. W. F. Brown, jun. (*Physical Rev.*, 1941, [ii], 60, 139—147; cf. A., 1941, I, 29).—Mathematical. The effect of dislocations is calc. by direct use of dislocation theory. The deviation from saturation is assumed to be due to magnetostrictive forces localised in the stress field about, rather than at, the dislocation. Pairs of dislocations of opposite sign, separated by a short distance, contribute a term a/H to the deviation from saturation. Pairs separated by a long distance and surplus dislocations of one sign contribute a term b/H^2 . From data for the variation of the empirical a and b with plastic strain, and assuming a val. for the distance Y between the members of a dislocation pair, the density of dislocations and the "block" length can be calc. The orders of magnitude agree with those obtained in the theory of hardening if Y is taken $\approx 2 \times 10^{-6}$ cm. All but $\sim 1\%$ of the dislocations appear to be members of such pairs. N. M. B.

Magneto-acoustic effect. M. R. Rao (*Physical Rev.*, 1941, [ii], 60, 156—157).—The magnetic anisotropy of the mols. of a liquid in a strong magnetic field results in a tendency to orient themselves relatively to the lines of force. The change to be expected in the velocity of sound is calc. from the thermodynamic equations. In PhNO_2 , which is strongly anisotropic, it is expected to be ~ 3 —4% at room temp. N. M. B.

Calculation of the energy of repulsion. II. M. F. Mamontenko (*Acta Physicochim. U.R.S.S.*, 1940, 13, 43—48; cf. A., 1940, I, 12).—The author's method is used to compute the energy of repulsion between Li^+ and H^- ions, and between two H_2 mols. F. J. G.

Thermal repulsion. L. A. Ramdas and S. Y. Joglekar (*Proc. Indian Acad. Sci.*, 1941, 13, A, 374—385).—Thermal repulsion of particles or objects in a convectionless thermal field has been investigated. The pressure is ~ 1000 times as large as the radiation pressure. The application to a thermal filter and a dust counter is described. W. R. A.

Forces between neutral molecules and metallic surfaces. H. Margenau and W. G. Pollard (*Physical Rev.*, 1941, [ii], 60, 128—134).—Mathematical. A general formula for the interaction between a neutral mol. and a metal is developed, and its relation to the image force law is shown. The latter is found to be valid only for mols. containing slowly moving charges, such as rigid permanent dipoles. An evaluation of the general formula involving empirical polarisabilities, f vals., and resonance frequencies is made, and numerical data for various gases and metals are tabulated. N. M. B.

III.—CRYSTAL STRUCTURE.

Diffuse reflexion of X-rays. M. Born (*Nature*, 1941, 147, 674; cf. A., 1941, I, 245).—Suggestions put forward by Raman, Bragg, and Preston are not accepted. The effect is a consequence of Debye's theory of the influence of thermal vibrations on the scattering of X-rays. The position of the spots is closely connected with the vibrational spectrum of the crystal, and the new interference effects are due, not to the geometry, but to the dynamics, of the lattice. L. S. T.

Quantum theory of X-ray reflexion. (Sir) C. V. Raman and P. Nilakantan (*Current Sci.*, 1941, 10, 241—245).—Irrespective of the crystal setting employed the modified reflexions by the planes in diamond appear with practically unaltered intensity when the crystal is cooled to liquid air temp. The reflexions are due to optical and not to acoustic vibrations of the lattice and are a quantum-mechanical effect. The Faxén formula is irrelevant and the modified reflexions arise from the fact that the phase-waves of the optical vibrations have a precisely determined orientation and azimuth with reference to the crystal planes. W. R. A.

Quantum theory of X-ray reflexion. (Sir) C. V. Raman, P. Nilakantan, and P. R. Pisharoty (*Nature*, 1941, 147, 805).—The view that the second kind of specular reflexion given by the lattice planes in a crystal is due to the scattering of X-rays by elastic waves of thermal origin (cf. A., 1941, I, 102) is criticised. Optical vibrations of the lattice are held to be responsible, and the intensity of the reflexions is determined, not by classical mechanics, but by quantum dynamics. L. S. T.

Diffuse spots in X-ray crystal photographs. (Sir) W. H. Bragg (*Nature*, 1941, 148, 112; cf. preceding abstract).—The pattern of diffuse spots in X-ray crystal photographs can be calc. from the first principles of wave interference. It is the true diffraction pattern of the crystal lattice considered as a three-dimensional grating. Neither thermal conditions nor elastic properties enter into the calculations. Up to the present, the agreement between this true diffraction pattern and the observed effects is within the errors of experiment, and the correlation extends to those details described by Lonsdale (see following abstract) for the diamond. L. S. T.

Diffuse X-ray diffraction from the two types of diamond. (Mrs.) K. Lonsdale and H. Smith (*Nature*, 1941, 148, 112—113).—Details of diffuse scattering in the two types of diamond are described and illustrated. In the normal type, the diffuse spots often show horn-like extensions, and division into groups of smaller spots. These secondary effects are absent in the scattering shown by the rarer and more transparent type of diamond. This disappearance eliminates the possibility that these secondary effects are due to thermally excited lattice vibrations. L. S. T.

Temperature study of the diffuse X-ray diffraction by diamonds. (Mrs.) K. Lonsdale and H. Smith (*Nature*, 1941, 148, 257—258).—Evidence that the two types of diffraction (see preceding abstract) shown by diamonds may have different origins is presented. In contrast to the primary diffuse spots, the secondary effects vary considerably in intensity for diamonds of similar shape and size. Type-I diamonds always show some effect, whereas type-II show none. Secondary diffraction is affected in intensity only slightly by a temp. change of $>800^\circ$, but the primary diffraction is more sensitive to temp. changes. Photographs illustrating temp. effect are reproduced. The primary diffuse spots, observed and temp.-sensitive for both types of diamond, appear to correspond with the diffuse spots observed for all other crystals under suitable conditions. The secondary spots and streaks of type-I diamonds are not typical of diffuse diffraction in general. L. S. T.

Presentation of crystal chemistry. A. F. Wells (*Phil. Mag.*, 1941, [vii], 32, 106—136).—A geometrical classification, based on interat. distances, is proposed for cryst. structures. Four main classes, involving finite, one-dimensional (chain), two-dimensional (layer), and three-dimensional complexes in the structure, are distinguished. These classes are subdivided according to the nature of the bonds between such complexes (van der Waals, H, or ionic bonds). Classifications according to bond type and according to bond strength for ionic crystals are discussed. L. J. J.

Determination of the orientation of aluminium single crystals by electron microscopy. H. Mahl (*Metallwirts.*, 1940, 19, 1082—1085).—By the deep etching of Al in a mixture of HF and HCl the cryst. structure is shown up by minute steps on the surface. These cannot usually be seen in an ordinary microscope, but are clearly shown by the electron microscope. Examples at magnifications of 3000—11,000 are shown. The orientation can be determined approx. by inspection of a photograph of the specimen, and a method is given for determining it more exactly by measurement of the difference in brightness of the different surfaces. C. E. H.

Study of the growth of chemical compounds on a copper single crystal by electron diffraction. I. H. Usmani (*Phil. Mag.*, 1941, [vii], 32, 89—105).—Electron diffraction from the surface of thin films of Cu_2I_2 , Cu_2Br_2 , Cu_2S , and Cu_2O , deposited electrolytically at low c.d. on an etched Cu single-cryst. surface, shows definite orientation relationships to the Cu base. The most densely packed (111) plane is in each case parallel to the (111) plane of the Cu. Cu_2I_2 , Cu_2Br_2 , and Cu_2S show spinel twinning about the (111) plane. Electrolytic Cu sulphide does not agree with the X-ray structure of either Cu_2S or CuS , but shows cubic symmetry with a unit cell of edge 4.058 Å. Direct action of H_2S gas on Cu gives a single crystal overlaid by a polycryst. structure. The single crystal structure has hexagonal symmetry, different from that obtained electrolytically and from that shown by X-rays. L. J. J.

X-Ray studies of compounds in the systems $\text{PbO}-\text{B}_2\text{O}_3$ and $\text{H}_2\text{O}-\text{PbO}-\text{SiO}_2$. H. F. McMurdie (*J. Res. Nat. Bur. Stand.*, 1941, 26, 489—494).—Interplanar spacings and estimated relative intensities are recorded for α - and β - $\text{PbO} \cdot \text{B}_2\text{O}_3$, α - and β - $\text{PbO} \cdot \text{B}_2\text{O}_3$, $5\text{PbO} \cdot 4\text{B}_2\text{O}_3$, $\text{PbO} \cdot 2\text{B}_2\text{O}_3$, $\text{K}_2\text{O} \cdot 4\text{PbO} \cdot 8\text{SiO}_2$, $\text{K}_2\text{O} \cdot \text{PbO} \cdot 4\text{SiO}_2$, $\text{K}_2\text{O} \cdot 2\text{PbO} \cdot 2\text{SiO}_2$ (I), and another $\text{K}_2\text{O}-\text{PbO}-\text{SiO}_2$ compound of unknown composition. (I) is hexagonal with a 5.62 \pm 0.02 and c 7.57 \pm 0.02 Å. J. W. S.

X-Ray study of the orientation of artificial fibres. I. V. A. Kargin and N. V. Michailov. II. N. V. Michailov, V. A. Kargin, and V. M. Buchman (*J. Phys. Chem. Russ.*, 1940, 14, 195—204, 205—207).—I. From X-ray patterns of rayon fibres the quant. angle distribution of cellulose chains is calc. It is a pure random distribution only for viscose rayon kept for 2 hr. in boiling H_2O ; all other samples show some preferred orientation. The degree of orientation is raised by stretching wet fibre and drying it under load; this treatment increases also the tensile strength of fibres both wet and dry, and reduces the total elongation of dry fibres. The orientation of stretched fibres is destroyed by boiling H_2O ; the fibres obtained have a high tensile strength when dry, and a very high total elongation both when wet and when dry. The disappearance of orientation in hot H_2O shows that the crystal-like state is not that of max. stability.

II. When a fibre of cellulose xanthate (I) is transformed into hydratocellulose (II), and the resulting fibre stretched, it shows an orientation. When the stretched fibre is kept for 2 hr. in boiling H_2O , however, this orientation disappears and the X-ray pattern becomes identical with that before stretching. When a fibre of (I) is first stretched and then transformed into (II), its orientation is not affected by boiling H_2O . The orientation obtaining during the formation of (II) is stable, probably due to links between cellulose chains, whereas an orientation produced by later deformations is "elastic." J. J. B.

Structure and properties of cellulose and its esters. XI. Nature of surface reactions in the course of esterification of cellulose. Z. Rogovin, N. Michailov, and M. Sverdlin (*J. Phys. Chem. Russ.*, 1940, 14, 208—210).—The X-ray pattern of $\text{Cu}-\text{NH}_3$ rayon changes when 42% of the OH radicals present are coupled with AcOH. This percentage is lower

than for ramie cellulose and shows that calculations of the micelle size from acetylation experiments are unconvincing. J. J. B.

Structure of black carbon. A. H. White and L. H. Germer (*J. Chem. Physics*, 1941, 9, 492—497).—Electron diffraction patterns of C films produced on SiO_2 by the thermal decomp. of CH_4 indicate that the C crystallites are strongly oriented. The films are made up of pseudo-crystals, in each of which the C atoms are arranged hexagonally in planes, as in graphite, but successive parallel at. layers are displaced so that no regularities exist other than the uniform separation of the planes and regular arrangement of the atoms in each plane. J. W. S.

Magnetisation in crystalline media. W. Peddie (*Phil. Mag.*, 1941, [vii], 32, 225—238).—Weber's theory of magnetisation is developed in application to a cubic cryst. medium. The theory accounts for all the normal phenomena of magnetisation. O. D. S.

Further investigations of solid n -paraffins. Repulsion potential and compressibility. A. Müller (*Proc. Roy. Soc.*, 1941, A, 178, 227—241).—The substances investigated were $n\text{-C}_{17}\text{H}_{36}$, m.p. 22°, $n\text{-C}_{23}\text{H}_{48}$, m.p. 47°, commercial wax, m.p. 58°, and $n\text{-C}_{29}\text{H}_{60}$, m.p. 64.5°. Compressibilities were measured by X-ray methods in the pressure range 700—1500 atm. Linear compressibilities in a plane normal to the chain axes are 3 to 12×10^{-12} cm.² per dyne; in the direction of the chain the figure is < one tenth of this. The repulsive forces between mols. are shown to have their origin in the H shells which surround the C chains. The forces are of the same order as those between He atoms. G. D. P.

Internal friction of single crystals of copper and zinc. T. A. Read (*Amer. Inst. Min. Met. Eng.*, 1941, *Tech. Publ.* 1309, 12 pp.; *Met. Tech.*, 1941, 8, No. 3; cf. A., 1940, I, 405).—The fraction of energy lost per $\frac{1}{2}$ -cycle when single-crystal rods of Cu and Zn are set in longitudinal vibration at 33.5 and 39 kilocycles per sec. by piezo-electric oscillations may be as low as 1×10^{-5} when the crystals are carefully annealed but is greatly increased by very small amounts of cold-work. The damping properties of Cu crystals do not change with time at room temp. and are not affected by the vibration stresses employed, but Zn crystals show recovery at room temp. and their damping is increased by oscillation stresses and depends on their orientation. The results are explained on the basis that internal friction is caused by slip and are discussed in terms of the dislocation theory. J. C. C.

IV.—PHYSICAL PROPERTIES OF PURE SUBSTANCES.

Ionic diamagnetic susceptibility and diamagnetic correcting constants. (Miss) V. C. G. Trew (*Trans. Faraday Soc.*, 1941, 37, 476—492).—The methods available for calculating ionic susceptibility are surveyed and critically discussed. A table of proposed vals. for univalent ions and for CO_3^{2-} and SO_4^{2-} is given. There is a systematic deviation between calc. and theoretical vals. The effect due to the homopolar bond, indicated by the difference between ionic vals. and those for the corresponding atoms in covalent combination, is not const., but rises regularly with increase in the effective at. no. F. L. U.

Adiabatic demagnetisation of paramagnetic salts. W. J. de Haas and E. C. Wiersma (*Act. VII Congr. int. Froid*, 1937, 2, 267—278; *Chem. Zentr.*, 1938, ii, 3896—3897; cf. A., 1940, I, 388).—Magnetic balance and ballistic methods for the determination of χ at $< 4^\circ \text{K.}$ are described. Temp. reached by adiabatic demagnetisation are calc. from χ , using the Curie law. A. J. E. W.

Influence of changes of structure and particle size on magnetic susceptibility. K. E. Zimens and J. A. Hedvall (*Svensk Kem. Tidsskr.*, 1941, 53, 12—23).— χ is unaffected by changes in particle size (measurements with TiO_2 and Se), but small differences in χ for different cryst. forms of the same substance occur (rutile, anatase, and amorphous TiO_2 ; blende and wurtzite; hexagonal, monoclinic, and amorphous Se; rhombic and monoclinic S). "Active" forms of S and TiO_2 of intermediate structure gave intermediate vals. of χ . Irradiation of Se and of ZnS phosphors had no effect on χ , probably because comparatively massive samples were used and thus only a small proportion of the atoms were activated. Vals. of χ for $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$, $\text{Na}_2\text{CO}_3 \cdot 4\text{H}_2\text{O}$, $\text{KAl}(\text{SO}_4)_2$, and alum show that the contribution of the H_2O mols. to the

vals. is additive; the H_2O mols. are thus not chemically combined. Changes of χ during the thermal dehydration of kaolin (pholerite) indicate that its H_2O is chemically combined, but that the H_2O in metakaolin is not.

M. H. M. A.

Magnetic studies of solid solutions. II. Properties of quenched copper-iron alloys. F. Bitter, A. R. Kaufmann, C. Starr, and S. T. Pan (*Physical Rev.*, 1941, [ii], 60, 134—138; cf. A., 1940, I, 67).—Susceptibility and magnetisation measurements are reported. The alloys studied show unusual magnetic properties both in the saturation effects at low temp. and in the apparent change in the magnetic moment of the dissolved Fe atoms over the temp. range 14—1300° K.

N. M. B.

Ferromagnetic properties of hæmatite. E. T. Hayes (*U.S. Bur. Mines*, 1941, *Rept. Invest.* 3570, 29 pp.).—The use of the Gouy-type magnetic balance has been extended to measure susceptibilities over a large range of field strength, and to permit the determination of the hysteresis const. of weakly ferromagnetic substances. The application of the method to hæmatite (I) shows the latter to be weakly ferromagnetic, with a max. susceptibility ~3500 oersted. Small amounts of impurities cause a rapid displacement of this max. to weaker fields. Hysteresis curves drawn between H and $4\pi I$ are unique for (I), since a ferromagnetic substance is being dealt with in a susceptibility range usually assigned to paramagnetic substances. Saturation occurs in fields of 8000—10,000 oersted. The residual magnetism of (I) after magnetisation in fields of this strength is 2—12 gauss. The vals. of the coercive force exceed those of any other natural mineral, and approach that of the best alloys for the construction of permanent magnets. The Curie point of (I) is ~685°.

A. J. M.

Velocity of sound in binary alloys. G. E. Allan (*Phil. Mag.*, 1941, [vii], 32, 165—170).—Observations are recorded for series of Sn-Pb, Sn-Zn, Cu-Zn, and Fe-Ni alloys. The relation between percentage composition and velocity of sound is roughly linear in the case of the Sn-Pb and Sn-Zn alloys, and shows a min. at ~50% in the Cu-Zn series, and at ~60% Fe in the Fe-Ni series, with inflexions in both cases at ~75% Cu and Fe, respectively.

L. J. J.

Cytochrome-c. II. Optical properties. IV. Magnetic properties of ferrous and ferric cytochrome-c.—See A., 1941, III, 793.

Data on theoretical metallurgy. IX. Entropies of inorganic substances. Revision (1940) of data and methods of calculation. K. K. Kelley (*U.S. Bur. Mines*, 1941, *Bull.* 434, 115 pp.; cf. A., 1937, I, 123).—Available data of the entropies at 298.1° K. of the elements and inorg. compounds are presented, with tables summarising sp. heat and entropy data and data concerning changes in state over the range 0—298.1° K., and explanations of the methods used in calculating entropies. A bibliography of 419 references is appended.

C. R. H.

Specific heat of β -brass. R. Eisenschitz (*Nature*, 1941, 147, 778; cf. A., 1939, I, 559).—Theoretical. A rigorous evaluation of the partition function at const. vol. is given for the two-dimensional quadratic lattice.

L. S. T.

Heat capacity of certain halomethanes. G. Glockler and W. F. Edgell (*J. Chem. Physics*, 1941, 9, 527—529).—A semi-empirical method of calculating C_p for the halogen derivatives of CH_4 , based on additive contributions of the bonds and angles present, is developed. The mean deviation from the vals. calc. statistically is 0.9%.

J. W. S.

Restricted rotation potential and frequency assignment in propylene. D. Telfair and W. H. Pielemeier (*J. Chem. Physics*, 1941, 9, 571).—The vals. of C_p for propylene at 360—500° K., as determined by supersonic methods are in accord with Wilson and Wells' frequency assignment (A., 1941, I, 241) and a rotation-restricting potential of ~2000 g.-cal. per g.-mol., but are in accord with Pitzer's assignment (A., 1937, I, 398) only if there is an entropy of mixing, which is regarded as improbable.

J. W. S.

Slopes of p_v isotherms of helium, neon, argon, hydrogen, nitrogen, and oxygen at 0°. C. S. Cragoe (*J. Res. Nat. Bur. Stand.*, 1941, 26, 495—536).—The methods of determining the variation of p_v with p or d at const. temp. and low pressure from available data are discussed with particular reference to the reliability of the vals. at 0°. These vals.

are of importance in at. wt. determination, gas thermometry, gas analysis, etc.

J. W. S.

Solid helium. T. Nagamiya (*Proc. Phys.-Math. Soc. Japan*, 1940, III, 22, 492—503; *Rev. Phys. Chem. Japan*, 1941, 15, 55).—On the assumption that the mean positions of the atoms in solid He form a cubic close-packed lattice and that each atom is in the lowest energy state in a mean field of force which is exerted on it by its neighbours, the energy-vol. curve of solid He at 0° K. has been calc. Agreement with experiment is good but this does not necessarily confirm the original assumptions.

J. W. S.

Equation of state of solid helium. G. Kane (*J. Chem. Physics*, 1941, 9, 568—570).—From Margenau's vals. of the potential energy of interaction between two He atoms (A., 1940, I, 59) and a consideration of the He crystal to be hexagonal and close-packed with an ideal axial ratio, the equation of state for solid He is derived. Agreement with experiment is rather poor. Nagamiya's calculation of the equation of state (preceding abstract) is invalidated by a mathematical error.

J. W. S.

Production of waves by the sudden release of a spherical distribution of compressed air in the atmosphere. J. J. Unwin (*Proc. Roy. Soc.*, 1941, A, 178, 153—170).—A theoretical method is devised for the solution of problems connected with the production of waves by spherical concns. of compressed air. A solution is worked out for a not very intense initial pressure, the results showing some features of interest in the differences to be expected from those predicted by sound-wave theory. The method is applicable to any spherically symmetrical motion up to such a time as the formation of a shock wave occurs and then it fails owing to the assumption of const. entropy.

G. D. P.

Viscosity and structure of molten quartz glass. N. V. Solomin (*J. Phys. Chem. Russ.*, 1940, 14, 235—243).—The coaxial-cylinder method was used, the outer cylinder being of graphite, and the inner one of W. The furnace was lined inside with C. At 1720°, 1800°, 1880°, 1940°, and 2000° η of SiO_2 (containing 0.01% of Al_2O_3) is 2.94×10^4 , 5.74×10^4 , 1.47×10^5 , 5.60×10^4 , and 2.825×10^4 poises, respectively. Molten SiO_2 presumably contains aggregates of some hundred mols.; the size of the aggregates is reduced by heating and by addition of metal oxides.

J. J. B.

V.—SOLUTIONS AND MIXTURES (INCLUDING COLLOIDS).

Compressibility of gas mixtures. I. P - V - T data for binary and ternary mixtures of hydrogen, nitrogen, and carbon dioxide. I. R. Kritschewski and V. P. Markov (*J. Phys. Chem. Russ.*, 1940, 14, 101—104).—Vals. are recorded for the mol. vol. of the mixtures H_2 , 49.5, N_2 , 50.5; H_2 , 73.6, CO_2 , 26.4; N_2 , 75.8, CO_2 , 24.2; H_2 , 31.5, N_2 , 35.2, CO_2 , 33.3; H_2 , 54.4, N_2 , 23.5, CO_2 , 22.1, and H_2 , 27.1, N_2 , 54.7, CO_2 , 18.1 between 50 and 500 atm. and 0° and 200°, and of the mixtures H_2 , 47.3, CO_2 , 52.7 and N_2 , 52.7, CO_2 , 47.3 between 50 and 500 atm. and 50° and 200°. The vals. are correct within 0.5%.

J. J. B.

Compressibility of hydrogen-nitrogen-methane mixtures at high pressures. P. Bolschakov and A. Ethernan (*Acta Physicochim. U.R.S.S.*, 1941, 14, 365—370).—Data on the compressibilities of H_2 - N_2 - CH_4 mixtures are recorded. The compositions of the mixtures and the experimental conditions were as follows: 64.4% H_2 + 25.0% N_2 + 10.6% CH_4 , at 50—800 atm. and -30° to 250°; 70.37% H_2 + 25.2% N_2 + 4.5% CH_4 , at 300—800 atm. and -30° to 50°.

F. J. G.

Determination of the azeotropic mixture of ethyl alcohol and m -xylene. P. Lebed (*J. Phys. Chem. Russ.*, 1940, 14, 277).—This contains EtOH 85 and xylene 15 wt.-%. Its heat of evaporation is 196 g.-cal. per g.

J. J. B.

Theory of azeotropic mixtures. V. A. Kireev (*Acta Physicochim. U.R.S.S.*, 1941, 14, 371—386).—The excess, F_m^E , of the observed over the ideal free energy of mixing for a binary mixture in which the mol. fraction of one component is m , is in the great majority of cases of the form $F_m^E = m(1-m)K$, where K may be either positive or negative and is a measure of the degree of deviation from linearity of the v.p.-composition curve. This leads to an equation $(1-2m) \log p_m = (1-m)^2 \log p_1 - m^2 \log p_2$, where p_1 , p_2 , and p_m are the v.p.

of the pure components and the azeotropic mixture, which gives good agreement with observation in all but the most abnormal cases. Further, on the assumption (which is true in many cases) that $KT = \text{const.}$, the dependence of the composition of the azeotropic mixture on the temp. is given by $-m/T^2 + 1/2T^2 + (L_1 - L_2)/2KT^2 + C = 0$, where C is an integration const. and L_1 and L_2 are the heats of vaporisation of the pure components. This also gives good agreement with observation. F. J. G.

Viscosity in the systems acetic acid-dimethylaniline and diethylaniline. V. V. Udoenko (*J. Gen. Chem. Russ.*, 1940, 10, 1923—1925).—The η - and d -composition curves at 25°, 45°, and 65° exhibit max. at 80—85 mol.-% of AcOH.

Relation between viscosity and density of liquids and liquid mixtures. M. K. Srinivasan (*Phil. Mag.*, 1941, [vii], 32, 253—258).—The variation of viscosity (η) of liquids and binary liquid mixtures with temp. can be represented by the empirical equation: $\log \eta = a + \beta/(\rho_0 - \rho)$, where ρ is the density of the liquid and a , β , and ρ_0 are consts. The equation agrees with published data for org. liquids, including the associated *tert.* alcohols, for org. binary mixtures, and for metals, but does not agree with data for H_2O . The equation also represents the variation of η with composition of binary mixtures at const. temp. O. D. S.

Influence of pressures up to 1000 kg. per sq. cm. on the viscosity of highly viscous liquids (lubricating oils etc.). M. P. Volarovitch (*Acta Physicochim. U.R.S.S.*, 1940, 13, 69—82, 564—565).—Data on the influence of high pressures on η for a no. of highly viscous liquids (lubricating oils, colophony, solutions of sugar in glycerol) are given. With increase of pressure, η increases markedly, approx. according to $\log \eta = a + bP$, and the temp. coeff. of η also increases. F. J. G.

Unmixing effect of sound waves on liquid mixtures. K. F. Herzfeld (*J. Chem. Physics*, 1941, 9, 513—514).—Mathematical. The amount of unmixing and increase in sound absorption produced when sound waves are passed through liquid mixtures are calc. and found to be too small to be observed. J. W. S.

Physical reflexions in a chemical mirror. R. E. Gibson (*J. Washington Acad. Sci.*, 1941, 31, 325—348).—A historical survey of the theory of solutions. F. L. U.

Density-composition tables for (A) nitric acid, (B) aqueous solutions of hydrochloric acid (*Brit. Stand. Inst.*, B.S. 975, 976, 1941; 58 pp., 31 pp.).

Diffusion of electrolytes and of the ions in their mixtures. J. R. Vinograd and J. W. McBain (*J. Amer. Chem. Soc.*, 1941, 63, 2008—2015).—The diffusion into H_2O at 25° through a sintered glass membrane of KCl, LiCl, NaCl, NaI, NaCN, $NaHCO_3$, Na_2SO_4 , Na_2 and Na H tartrates, Na citrate, and tartaric acid has been measured. The diffusion of ions in mixed electrolytes diffusing in the same and opposite directions or of ions diffusing through salts or buffers originally present in uniform concn. is considered theoretically, and the effects due to concn. gradient and to electrical factors produced by the diffusion potential are assessed separately. W. R. A.

Electric conductivity and viscosity of the systems pyridine hydrochloride-pyridine and pyridine hydrochloride-water. S. Z. Schtamova (*J. Phys. Chem. Russ.*, 1940, 14, 225—234).—The η of $C_5H_5N.HCl-C_5H_5N$ mixtures between 95° and 135° and of $C_5H_5N.HCl-H_2O$ mixtures between 55° and 135° increases regularly with $[C_5H_5N.HCl]$, showing that no compounds are formed in these systems. Electric conductivity κ increases with $[C_5H_5N.HCl]$ in C_5H_5N and has a max. in H_2O ; after correcting for η it increases with $[C_5H_5N.HCl]$ in H_2O as well. The mol. conductivity corr. for η has in the C_5H_5N solution a min. at 0.18 l. per mol. at 115°, and in aq. solution a min. at 0.18 l. per mol. at 95°. The temp. coeff. of κ in C_5H_5N between 95° and 115° is 1.1% per degree independently of temp.; in H_2O the temp. coeff. increases with $[C_5H_5N.HCl]$. The results show that an anomalous behaviour of mol. conductivity is also observed in systems involving no interaction between solution and solvent. J. J. B.

Mixed crystals. III. M. M. Popov, S. M. Skuratov, and I. N. Nikonova. IV. M. M. Popov, S. M. Skuratov, and M. M. Streltsova. V. M. M. Popov, J. P. Simonov, S. M. Skuratov, and M. N. Suzdaltzeva (*J. Gen. Chem. Russ.*, 1940, 10, 2017—2022, 2023—2027, 2028—2040).—III. The mean

sp. heat (20—610°) of 1:1 KCl-KBr mixed crystals is 0.4% > that of a 1:1 KCl-KBr mixture, and that of 1:1 NaCl-KCl mixed crystals 0.6% > that of 1:1 NaCl-KCl mixture.

IV. Mixed KCl-KBr or NaCl-KCl crystals, prepared by fusion of the salt mixtures, are stable in absence of H_2O . The heat of dissolution of the mixed crystals is < that of the corresponding mixtures.

V. Mixed crystals prepared as above present numerous X-ray spectrum lines not given by the constituent salts, unless these have previously been subjected to the same thermal treatment. Metastable forms of Ag, Au, and Pt may be obtained similarly. R. T.

Densities of silicate glasses as a function of composition. M. L. Huggins (*J. Opt. Soc. Amer.*, 1940, 30, 420—430).—The vol. V_0 per g. of O is calc. for a series of well annealed glasses from published data of their densities. Results can be expressed accurately by $V_0 = k + b_{Si} + c_{Si}N_{Si} + \Sigma c_M N_M$, where k is a very small const. depending on the annealing technique, N_{Si} and N_M are nos. of Si or other "metal" atoms per O atom respectively, b_{Si} and c_{Si} are consts. different for different ranges of N_{Si} vals., and c_M is a const. valid for all vals. of N_M . For glasses containing B allowance must be made for the presence of both tetrahedrally surrounded and triangularly surrounded B atoms. Densities can be calc. for glasses of known composition with an accuracy of 0.1%. The physical significance of the empirical formula is discussed. O. D. S.

Speed of crystallisation of some silicate glasses as a function of viscosity. A. Leonteeva (*Acta Physicochim. U.R.S.S.*, 1940, 13, 423—428).—The trend of the curve of max. linear speed of crystallisation (v) against temp. (T) observed by Dietzel (B., 1930, 460) is in the opposite sense to the η - T curve measured on similar glasses by Washburn (*Univ. Ill. Eng. Exp. Sta. Bull.*, 1924, 140) and it is shown that for temp. below the temp. of max. v , $v = k/\eta + k_0 \log \eta$, where k and k_0 are consts., the vals. of which differ for different glasses. J. W. S.

Platinum-mercury system. I. N. Plaksin and N. A. Suvarovskaja (*Acta Physicochim. U.R.S.S.*, 1940, 13, 83—96).—Methods for the prep. and analysis of Pt amalgams are described, and the results of a study of the system Pt-Hg by means of X-rays and cooling curves are recorded. The following phases exist: α , a solid solution of Hg in Pt having > 23 at.-% of Hg, and β , γ , and δ , three compounds of approx. compositions Pt_3Hg , Pt_2Hg , and $PtHg$. α decomposes at 486.1° to solid solution and liquid, and β and γ decompose at 236.5° and 159.1° respectively to the compound poorer in Hg and liquid. The solubility of Pt in Hg is 0.02% at 16° and 1.2% at 172°. F. J. G.

Solubility of gases in liquids at low temperatures and high pressures. II. Solubility of helium in liquid nitrogen at 78.0—109.0° K. and pressures up to 295 atm. M. G. Gonikberg and V. G. Fastovski (*J. Phys. Chem. Russ.*, 1940, 14, 257—260).—The ratio of the mol. fractions of He in gas and liquid corr. for the activity coeff. is 4290, 2450, and 770 at 78.0°, 90.1°, and 109.0° K. respectively for low $[He]$. When the liquid contains 4% of He the gas contains at 78° 98.3%, at 90.1° 91%, and at 109.0° 60% of He. J. J. B.

Solubility of gases in liquids at low temperatures and high pressures. IV. Solubility of helium in liquid methane at 90.3° and 106.0° K. and pressures up to 160 atmospheres. M. G. Gonikberg and V. G. Fastovski (*Acta Physicochim. U.R.S.S.*, 1940, 13, 399—404; cf. A., 1941, I, 80).—The distribution of He between liquid CH_4 and the vapour phase has been studied at 90.3° and 106.0° K. and at 26—160 atm., under which conditions it behaves in accordance with the dil. solution law. Henry's coeff. is 26,350 and 13,700 and the partial mol. vol. of the dissolved He is 18.4 and 20.2 c.c., at 90.3° and 106.0° K., respectively. J. W. S.

Solubility of hydrogen in liquid hydrocarbons. H. Sattler (*Angew. Chem.*, 1940, 53, 513).—The solubility of H_2 in C_6H_{14} , cyclohexane, C_6H_6 , and *m*-xylene at H_2 pressures of 50, 100, and 150 atm. and at 35° and 72° was studied. The liquids were in thermodynamic equilibrium with the H_2 , and the quantity of H_2 evolved from a known quantity of the liquid at its own v.p. was determined volumetrically. Apparatus and procedure are described. At the pressures used, Henry's law is still applicable. The solubilities in c.c. of gas at n.t.p. per g. of solvent, at a H_2 pressure of 10 atm., are:

C_6H_{14} 16.7, cyclohexane 10.9, C_6H_6 7.8, and *m*-xylene 7.4 at 35°. Inaccuracy in measurement was <1%. At 72° the solubility of H_2 in C_6H_6 under the above conditions is 10.2. The theoretical significance of the variation of the solubility of a gas in chemically similar solvents is discussed.

Solubility of sulphur dioxide in molten copper. C. F. Floe and J. Chipman (*Amer. Inst. Min. Met. Eng.*, 1941, *Tech. Publ.* 1308, 10 pp.; *Met. Tech.*, 1941, 8, No. 3).—The solubility at 1100–1500° under pressures of 20–900 mm. of Hg was determined by a modified Sieverts method, using induction heating to melt the Cu which was contained in a fused SiO_2 tube. The results cannot be simply interpreted on the basis that chemical combination ($6Cu + SO_2 = Cu_2S + 2Cu_2O$) occurs, the deviation being most marked at low pressures, apparently owing to irregular behaviour of the dil. solutions. At 1100°, the solubility is 8.3 c.c. per 100 g. at 13.9 mm. and 165.5 c.c. per 100 g. at 893 mm.; at 1300° it is 251 c.c. per 100 g. at 752 mm. of Hg. J. C. C.

Physical studies of non-aqueous solvates. IV. Solubility of zinc bromide in diethyl ether. H. H. Rowley and R. B. Anderson (*J. Amer. Chem. Soc.*, 1941, 63, 1908–1910; cf. A., 1939, I, 523).—The existence of $ZnBr_2 \cdot 2Et_2O$ (stable below 4°) and $ZnBr_2 \cdot Et_2O$ (stable below 16–17°) has been demonstrated by measuring the solubility of $ZnBr_2$ in Et_2O from –20° to 35°. The differential heats of dissolution have been calc. for the whole range of temp. W. R. A.

High mol. wt. aliphatic amines and their salts. II. Solubilities of primary aliphatic amine hydrochlorides and acetates in ethyl alcohol and benzene. H. J. Harwood, A. W. Ralston, and W. M. Selby (*J. Amer. Chem. Soc.*, 1941, 63, 1916–1920).—The solubilities of the hydrochlorides of the amines from C_{10} to C_{18} in 95% EtOH and of the acetates of the same amines in 95% EtOH and in C_6H_6 have been determined in the range ~8–82°. The solubility curves of the hydrochlorides are paired with the "even" derivative and the next homologue almost superposed and sometimes intersecting. The relationship between the solubility curves for the acetates is much more complicated. Polymorphic forms of octa- and hexa-decylamine acetates separate from EtOH but not from C_6H_6 . W. R. A.

Fractional partition of the rare earths. D. B. Appleton and P. W. Selwood (*J. Amer. Chem. Soc.*, 1941, 63, 2029).—A mixture of La_2O_3 and Nd_2O_3 , containing 38.1% of La_2O_3 , was converted into the thiocyanates and an aq. solution shaken with an equal vol. of Bu^+OH . After separation into two layers each layer was analysed by conversion into oxides. The H_2O layer contained 38.7% La_2O_3 and the alcoholic layer 37.4% La_2O_3 . The process can be carried on continuously and a comparatively rapid separation effected. W. R. A.

Quantitative expression for the extractability of metals in the form of dithizonates from aqueous solutions. Equilibrium constant of zinc dithizonate. I. M. Kolthoff and E. B. Sandell (*J. Amer. Chem. Soc.*, 1941, 63, 1906–1908).—A quantitative expression for the extractability of metals as dithizonates has been derived from mass action and distribution laws and is tested for the Zn–dithizone equilibrium. W. R. A.

Kinetics of sorption and desorption. J. L. Zabeshinski (*J. Phys. Chem. Russ.*, 1940, 14, 139–141).—The slowness of desorption as compared with sorption can be accounted for if the rate of sorption $\propto (C_0 - C)$ and the rate of desorption $\propto C$, C_0 being the actual concn. of the vapour and C the concn. which would have been in equilibrium with the amount absorbed at a particular time. J. J. B.

Rate of sorption of sulphur dioxide by vanadium pentoxide. G. K. Borekov and E. E. Ruderman (*J. Phys. Chem. Russ.*, 1940, 14, 161–170).—The V_2O_5 was in crystals of 10^{-4} cm. The initial pressure of SO_2 was 750 mm. Hg. Between 273° and 418° the rate v of sorption gradually decreases and becomes negligible when the sorbed amount reaches ~0.2 c.c. per 1 g. of V_2O_5 . Between 443° and 494° v is high and almost independent of the amount adsorbed; at 490°, e.g., it is 3 c.c. per 1 g. of V_2O_5 per hr. V_2O_5 heated several times with O_2 at 494° and evacuated takes up SO_2 more rapidly, both at 494° and at 393°, but an analogous treatment at 393° does not affect v . After sorption at 494° the sorbent contains the whole adsorbed amount as SO_3 , and an equiv. amount of V_4O_{14} . This reduction of V_2O_5 cannot be a part of the cata-

lytic oxidation of SO_2 in the presence of V_2O_5 since the rate of sorption is about 100 times as small as the rate of oxidation. Below 418° only adsorption on the crystal surface takes place. J. J. B.

Adsorption of vapours under pressures. I. R. Kritschewski and R. S. Kalvarskaja (*Acta Physicochim. U.R.S.S.*, 1940, 13, 49–68).—The influence of hydrostatic pressure on the adsorption of a vapour has been studied theoretically and experimentally. It is shown thermodynamically that at const. chemical potential the adsorption decreases with increasing hydrostatic pressure. Experimentally, the adsorption of C_6H_6 and of CCl_4 on activated charcoal at 50° under pressures of 1–600 atm. of N_2 or H_2 was determined. The theoretical prediction was confirmed, the effect being > that calc. from Polanyi's theory, showing that the mol. vol. in the adsorbed is > in the liquid state. At const. mol. fraction in the gas phase, with increasing pressure, the adsorption passes through a max. when the partial mol. vols. in the gas and in the adsorbed state are equal. Data on the saturation concn. of CCl_4 and C_6H_6 vapours in compressed N_2 are also given. F. J. G.

Synthetic resins as exchange adsorbents.—See B., 1941, II, 352.

Theory of capillary condensation and other capillary phenomena taking into consideration the disjoining effect of multi-molecular liquid films. B. Derjaguin (*J. Phys. Chem. Russ.*, 1940, 14, 137–147).—Because of the disjoining effect of thin films (cf. A., 1940, I, 111) capillary condensation may cause swelling of the sorbent. This effect is also involved in the capillary rise in slits and cylindrical capillaries. J. J. B.

Electrocapillary curves of mercury in liquid ammonia. III. Surface-active organic substances. A. Murtazaev and I. Igamberdiev (*J. Phys. Chem. Russ.*, 1940, 14, 217–219).—The curves in 0.1N- NH_4NO_3 are depressed by hydrocarbons between +0.2 and –0.4 v.; no measurements were possible at higher positive potentials. The depression at the max. of the electrocapillary curve in 0.5M. solutions rises from 1.9 dynes per cm. for C_6H_6 to 14.6 dynes per cm. for mesitylene. Hydrocarbons do not shift the max. of the curve. J. J. B.

Adhesion of mineral particles to air bubbles. O. S. Bogdanov and M. S. Filanovski (*J. Phys. Chem. Russ.*, 1940, 14, 244–247).—Motion pictures are made of air bubbles and PbS particles meeting each other and moving together in H_2O containing Bu xanthate and pine oil. The speed of small particles sliding along the interface bubble/ H_2O is calc. J. J. B.

Structure of surface layers of ordinary solutions. B. M. Gouguell (*Acta Physicochim. U.R.S.S.*, 1941, 14, 433–450).—For binary solutions the mixture rule $a_1\gamma_1 + a_2\gamma_2 = \gamma$ is obtained, where γ denotes surface tensions and a mol. area fractions, defined by $a_1 = s_1A_1/(s_1A_1 + s_2A_2)$, s_1 and s_2 being the surface mol. fractions, and A_1 and A_2 the mol. areas; the subscripts refer to the two components. In the resulting expression $(\gamma_1 - \gamma)/(\gamma - \gamma_2) = s_2A_2/s_1A_1$, which gives a relation between the individual γ vals. and the composition of the surface layer, A represents an apparent mol. area, which is not necessarily const. but may vary with the orientation of the surface mols. The expression is checked by assuming parachor additivity according to the equation $s_1[P]_1 + s_2[P]_2 = (\gamma^2/\rho)(s_1M_1 + s_2M_2)$, where M is the mol. wt. of the components and ρ the density of a solution of the composition s_1 (or s_2). Very good agreement is found between observed vals. of γ and those calc. by the mixture rule after obtaining s and A vals. by applying the parachor expression, for the systems H_2O –AcOH, H_2O –MeOH, H_2O –EtOH, H_2O –PrOH, and H_2O – $COMe_2$. The compositions of the surface layers obtained are used to calculate adsorption and mol. areas of the components. A vals. for the alcohols exhibit a sharp min. in fairly dil. solution corresponding with vertical orientation, and then increase with increasing concn., presumably as a result of changed orientation. The composition at min. A is the same as that at which foam stability is a max., and it is suggested that at such a composition the alcohol and H_2O mols. form a condensed film. In AcOH solutions A shows a min. followed by a max., and the val. for pure AcOH is exactly half that for vertically oriented AcOH mols., indicating that the surface layer in pure AcOH is bimol. as in the solid fatty acids. F. L. U.

Effect of surface films on the rate of evaporation of water and aqueous solutions. A. S. Cheinman (*J. Phys. Chem. Russ.*, 1940, 14, 118—123).—The rate K of evaporation of H_2O from 0.5–0.75% gelatin solution is < that from H_2O ; the difference increases with the speed v of the air blowing away the vapour and reaches 3% when v is 1.44 m. per sec. This effect is due to the gelatin reducing the stirring of the surface by the air blast. A saturated film of cetyl alcohol reduces K of H_2O by 20% at $v = 0$ and by 67% at $v = 1.36$; this reduction is intensified by NaCl in the underlying H_2O . A solid film of Na oleate does, and a liquid film of oleic acid does not, lower K . Solid paraffin films are ineffective.

J. J. B.

Thermodynamic theory of the spreading of liquids to form duplex films and of liquids or solids to form monolayers. W. D. Harkins (*J. Chem. Physics*, 1941, 9, 552—568).—A thermodynamic theory of the spreading of any liquid or solid over the surface of a liquid is developed. It is considered that both duplex and monolayer spreading can occur, and conditions under which the two forms of spreading occur are deduced. The passage of the unstable duplex layers into monolayers and lenses is discussed. The action of a spreading oil in inducing the spreading as a duplex film of a non-spreading oil is also discussed.

J. W. S.

Spreading of oils on water. I. Ionised molecules having only one polar group. W. A. Zisman (*J. Chem. Physics*, 1941, 9, 534—551).—The spreading on H_2O of drops of mineral oil containing various org. acids and amines with one polar group has been studied under conditions favouring dissociation at the oil- H_2O interface. Max. spreading is induced by a substratum of p_H 9.0–10.5. Only acids containing <14 C atoms and having one straight saturated chain form rigid interfacial films on substrata containing Ca^{++} , Cu^{++} , Pb^{++} , Fe^{+++} , Al^{+++} , La^{+++} , or Th^{+++} . The ions of higher valency have the greatest effect. The areas of some OH-acid films are unaffected by p_H or by the presence of metallic ions. The effect of Ca^{++} on the spreading of oleic acid-stearic acid mixtures has been studied in detail.

J. W. S.

Surface films of polar crystals. (Sir) J. Larmor (*Nature*, 1941, 148, 26).

L. S. T.

Damping of waves by surface-active substances. I, II. V. Levitsch (*Acta Physicochim. U.R.S.S.*, 1941, 14, 307—320, 321—328).—I. Mathematical. It is shown that the presence of a surface film, independently of its nature, will always have a damping effect on surface waves.

II. Mathematical. A solute which is strongly adsorbed at the surface will have a damping effect analogous to that of a surface film.

F. J. G.

Internal phase and emulsifier as factors determining the viscosity of oil-in-water emulsions. B. A. Toms (*J.C.S.*, 1941, 542—547).—The viscosity η of 50 vol.-% emulsions of 11 different org. liquids in H_2O was measured at 20°, the Na and K salts of do-, tetra-, hexa-, and octa-decoic and oleic acids being used as emulsifiers. If the vol. fraction of the internal phase is calc. by Hatschek's equation, the ratio (h) of the calc. to the actual val. is not appreciably affected by substituting K for Na, but may be changed by 10–20% by altering the fatty acid radical; for the saturated acids $h = \sim 1.3$, whilst for oleic $h = \sim 1.2$. Alteration of the org. liquid, other factors remaining const., can lead to considerable variations in h . The observed variations are attributed to interactions between oil, soap, and H_2O .

F. L. U.

Particle size and shape of colloidal carbon.—See B., 1941, I, 431.

Calculation of particle size and mol. wt. from current centrifugal methods. J. W. McBain and F. A. Leyda (*Acta Physicochim. U.R.S.S.*, 1941, 14, 421—432).—Formulæ applicable to various forms of centrifugal and ultracentrifugal equipment are given. Numerical data for haemoglobin and for sucrose are recorded.

F. L. U.

Sedimentometric study of coarse disperse systems. Influence of the concentration of the disperse phase on the particle size distribution of aqueous suspensions of barium sulphate in the presence of electrolytes. N. A. Figurovski and V. N. Rozanova (*J. Phys. Chem. Russ.*, 1940, 14, 73—81).—A sedimentometric balance was used. In suspensions of well washed $BaSO_4$ the relative no. of small particles (1–2 μ) slightly increases, and that of large particles (7–10 μ) slightly decreases, with increase of dilution d (50–2000 g. of

H_2O per g. of $BaSO_4$). In the presence of 7×10^{-6} or 18×10^{-6} g. of NaOH per c.c. a min. of the degree of dispersity is observed at $d = 200$ or 100. At $d = 200$ small concns. of NaOH increase, and large concns. reduce, the dispersity. H_2SO_4 (9×10^{-6} to 2×10^{-4} g. per c.c.) and NaCl (2×10^{-5} to 5×10^{-5} g. per c.c.) lower the dispersity.

J. J. B.

Preparation of colloidal suspensions of metals and their alloys. E. Andronikaschvili and I. Tzabadze (*Acta Physicochim. U.R.S.S.*, 1940, 13, 369—378).—Conc. colloidal suspensions of Pb, Sn, and Pb-Sb and Sn-Pb alloys in EtOH, xylene, or Et₂O have been obtained by agitating the finely divided metal with the solvent. With Pb in EtOH the concn. reached 10%. The η of the conc. sols is > that of the pure liquids. The degree of dispersion, concn., and η are dependent on the initial particle size and the conditions of agitation. In spite of precautions to exclude O_2 , considerable oxidation of the particles occurs. Coagulation occurs after 2–3 days, the process being accelerated by the presence of air. The production of the dispersions is attributed to the mechanical disintegration brought about by collision between the particles in the earlier stages and rubbing together of the particles in the later stages of the agitation.

J. W. S.

Nature of lyophilic sols. S. A. Glückmann (*Acta Physicochim. U.R.S.S.*, 1940, 13, 379—392).—It is suggested that very dil. solutions of highly polymerised compounds are analogous to true solutions, but that at a definite concn. association begins and increases with increasing concn. The aggregates should be regarded as suspended in the liquid and in mobile equilibrium with mols. in solution. Thus very dil. solutions are bivariant, but more conc. solutions univariant. The stability of the sols is attributed to the predominance of the attractive force to the solvent over the attraction to the aggregate. Coagulation is caused by shifting of the adsorption equilibrium on the solvated part of the aggregate. The theory is supported by observations of the η and vol. changes during addition of coagulant liquids to lyophilic sols (cf. A., 1936, 1066).

J. W. S.

Rheology of clay. H. H. Macey (*J. Sci. Instr.*, 1941, 18, 159—165).—Theoretical and experimental investigations of the rheological properties of liquid and solid clay- H_2O mixtures are reviewed critically. The properties of the solid mixtures can be explained on the theory that the surfaces of the particles are mutually repulsive and so appear to be separated by H_2O films.

J. W. S.

Electron microscope study of curd fibres of sodium laurate. L. Marton, J. W. McBain, and R. D. Vold (*J. Amer. Chem. Soc.*, 1941, 63, 1990—1993).—The structure of Na laurate (I) curd has been investigated photographically, using an electron microscope. The curd consists of a mass of fibres which are thin ribbons, the widths of which tend to integral multiples of twice the length of mols. of (I). The rigidity of the curd is attributed to the fibres branching to form a felt. Capillary spaces of variable diameter, in which H_2O is retained at low R.H., are formed at the fibre junctions. Part of (I) is present in the curd as granules 100 to 200 Å. in diameter irregularly spaced along the fibres. The structure of the curd is in accord with previous deductions from microscopic and ultra-microscopic data for curd fibres.

W. R. A.

Process of viscous flow in highly-polymeric materials. V. Kargin and G. Slonimski (*Acta Physicochim. U.R.S.S.*, 1941, 14, 329—336).—The relationships of viscous flow in plastic materials to the classical conceptions of the deformation of an elastic solid and the flow of a viscous liquid are discussed. In substances having long-chain mols., the first effect of a stress will be to produce a deformation of the individual mols., which is not equally distributed along the chain. Subsequently a relaxation process will equalise this deformation along the chain. At the same time a shift of the chain as a whole with respect to its neighbours may also occur, and the relative speeds of these processes will depend on the relative binding forces within a chain and between different chains, and on the mutual orientation of the chains.

F. J. G.

Intraglobular absorption of organic substances by protein solutions. D. L. Talmud (*Acta Physicochim. U.R.S.S.*, 1941, 14, 562—563).—Solutions of globular proteins can absorb the vapours of org. substances insol. in H_2O in considerable amount; e.g., edestin in 2% solution in 10% aq. NaCl absorbs up to half its wt. of C_6H_{12} . This behaviour is compared

with that of soap solutions, and its further study is considered likely to throw light on the structure of protein mols.

F. L. U.

Physical-chemical investigation of certain nucleoproteins. III. Molecular-kinetic studies with calf thymus nucleohistone. R. O. Carter (*J. Amer. Chem. Soc.*, 1941, **63**, 1960—1964; cf. A., 1941, I, 261).—The sedimentation velocities at 20° over the p_H range 5–12 and the diffusion and sedimentation equilibria at 25° and p_H 6.4 of the nucleohistone (I) of the calf thymus gland have been measured. (I) is essentially monodisperse and shows the same mol. behaviour over the p_H range 5.3 to 9. The mol. wt. of (I) computed from the sedimentation and diffusion data is 2,150,000. The ratio of the long to the short axis is 36. W. R. A.

Effect of organic dye ions on electrokinetic potential at the glass-water interface. D. O. Jordan (*Trans. Faraday Soc.*, 1941, **37**, 441—450).—Streaming potentials at sintered glass plates were measured with solutions of new-fuchsine, orange II, Congo-red, benzopurpurine 4 B, and sky-blue FF, the last two also in presence of dil. NaCl. The variation of the electric moment of the double layer (thickness of double layer \times surface density of charge) with time and concn. is shown in diagrams. The dyes that form colloidal micelles in solution separate in a solid form at the interface.

F. L. U.

Evidence for a rigid multilayer at a solid-liquid interface. W. G. Eversole and P. H. Lahr (*J. Chem. Physics*, 1941, **9**, 530—534).—Assuming the presence of an immobile layer of electrolyte solution in contact with a wall of fixed potential, equations are derived interrelating the wall potential, ζ -potential, and concn. (c) of the univalent salt solution. Introduction of literature data for the relationship between ζ -potential and c leads to vals. of 8–63 Å. for the thickness of the immobile layer, this being considered to support the hypothesis of the immobile layer and to indicate that the assumption of large sp. adsorption potentials (A., 1933, 1304) is unnecessary. J. W. S.

Electrokinetic behaviour of carbon. N. Bach (*Acta Physico-chim. U.R.S.S.*, 1941, **14**, 463—482; cf. A., 1938, I, 244).—Sugar C, de-ashed, activated in CO₂ at 950°, and heated in H₂ to remove surface oxides, acquires a positive charge when placed in H₂O in presence of O₂. Under these conditions the C behaves as an O electrode and adsorbs anions but not cations. When such C is heated in O₂ at 350–450° acid-forming surface oxides are produced and the C then becomes negatively charged in H₂O and adsorbs cations to an extent increasing with the degree of oxidation. The sign of the charge deduced from the adsorption of anions and/or cations from 0.004N-KCl agrees in every case with that determined electrokinetically. The failure of Bennister and King (A., 1938, I, 450) to obtain positively charged C is attributed to surface oxidation consequent on allowing the C to cool in air after activation; C prepared by their method and afterwards cleaned in H₂ is positive in H₂O and dil. electrolytes in presence of O₂. Graphite, when treated as described above, is also positively charged in presence of O₂, but differs from the sugar C in being sensitive to O₂ at room temp.; the mobility of a specimen of graphite in H₂O was +5.6 μ . per cm. when freshly prepared, +4 μ . after keeping 1 month in O₂, and –3.6 μ . after 3 months. Both graphite and sugar C are negative in 0.004N-NaOH even when freshly prepared. Sugar C containing 0.2% of Pt is negatively charged in aq. solutions in presence of H₂ as a result of its then functioning as a H electrode. The ζ -potential vals. for such negative H₂-charcoal and for the positive O₂-charcoal, calc. from mobility measurements at different p_H , are consistent with the Gouy-Stern theory if the double layer is assumed to be either less diffuse than is provided by the theory, or more viscous than the bulk liquid. F. L. U.

Coagulation of colloids by exposure to high-frequency oscillations. S. S. Joshi and A. Purushottam (*J. Indian Chem. Soc.*, 1941, **18**, 138—140).—High-frequency oscillations from a condensed spark discharge produce rapid coagulation of many (but not all) colloids. F. J. G.

VI.—KINETIC THEORY. THERMODYNAMICS.

Equilibrium in chloride formation from mono-, di-, and tri-arylcannabinols. J. O. Halford and E. B. Reid (*J. Amer. Chem. Soc.*, 1941, **63**, 1873—1878).—The equilibria in the liquid

phase (C₆H₆ solution) at 60° of the reaction ROH + HCl = RCl + H₂O [R = CH₂Ph (I), *p*-xylyl (II), CHPh₂ (III), *o*-, *m*-, and *p*-methylbenzhydryl, di-*p*- (IV) and di-*o*-tolylmethyl, *o*- and *p*-chlorobenzhydryl, 4:4'-dichlorobenzhydryl, *p*-phenylbenzhydryl, CPh₃, and tri-*p*-tolylmethyl] have been investigated. The v.p. at 60° of ROH and RCl [R = (I), (II), (III), and (IV)] and the partial pressures of the solvent over their solutions in C₆H₆ have been measured. From these data the vapour-phase equilibrium consts. have been calc. For the other eight reactions estimates of the vapour-phase consts. have been made. W. R. A.

Calculations of p_H in buffer solutions on basis of Debye and Hückel's theory. H. Nukada (*J. Pharm. Soc. Japan*, 1940, **60**, 242—246).—The Debye-Hückel equation for the calculation of p_H cannot be applied in highly conc. solutions of strong electrolytes; for these the empirical equations of Bjerrum or of Brønsted must be used. Most of the buffer solutions in practical use are within the limits of applicability of the Debye-Hückel equation. Even within this concn., however, the activity coeff. is different according to the concn. of the solution, particularly when the latter is largely diluted. For this reason the correct val. of a to be used in the equation differs according to the concn. of the solution. If the difference in dissociation const. between steps of dissociation in polybasic acids is not great, the calculation becomes highly complex owing to the influence of various ions on one another. Calculations are given for the following: M./15 KH₂PO₄ + M./15 K₂HPO₄; 0.1M-AcOH + 0.1M-NaOAc; 0.1M-NaOH + 0.1M-K H phthalate. H. W.

Influence of solvent on relative strengths of monocarboxylic acids. J. F. J. Dippy (*J.C.S.*, 1941, 550—552).—The results obtained by Elliott and Kilpatrick (A., 1941, I, 210) for the strengths of substituted benzoic acids give general support to the author's contention that the order of strengths is not affected by the nature of the solvent. The exceptions, e.g., salicylic and *o*-toluic acids, are due to the operation of special factors such as H bond formation, which may reasonably be expected to vary with the solvent. Measurements of the dissociation const. K of CHPh₂·CO₂H, BzOH, CH₂Ph·CO₂H, CHPh₂·CH·CO₂H, Ph[CH₂]₂·CO₂H, and EtCO₂H in H₂O, 25% aq. COMe₂, and 20% aq. sucrose show that K decreases in the order given in all three solvents. F. L. U.

Relative strengths of acids and bases. E. C. Lingafelter (*J. Amer. Chem. Soc.*, 1941, **63**, 1999—2000).—The strength of an acid or base is measured by the equilibrium const. K = [neutralisation compound]/[acid][base] and varies with the reference acid used. Thus, using H⁺, CN' ~ NH₃ > SO₃'' whilst, using Ag⁺, CN' > SO₃'' > NH₃. Further, using H⁺, CN' > Cl' > Br' > I'; using Cu⁺, CN' > I' > Br' ~ Cl'; and, using Hg²⁺, CN' > I' > Br' > Cl'. Therefore, in agreement with Lewis (A., 1938, I, 574) but contrary to Luder (*Chem. Rev.*, 1940, **27**, 547), neither acids nor bases can be arranged in a monotonic series. W. R. A.

Local dielectric constant and solute activity. Hydration-association model for strong electrolytes. H. S. Frank (*J. Amer. Chem. Soc.*, 1941, **63**, 1789—1799).—The Debye-Pauling expression for the effect of local dielectric const. (ϵ) on the electrostatic free energy of a central ion due to its ionic cloud is derived by a new method. If ϵ is <25 and if the ions can approach each other to distances equal to the sum of their crystal radii, the Debye-Pauling expression predicts, in disagreement with experiment, large negative deviations from the Debye-Hückel limiting law for activity coeffs. even in very dil. solutions. By assuming that the ions in aq. solution are hydrated and take part in an association equilibrium agreement is obtained. The assumption is in harmony with modern views on the structure of liquids. Vals. of the correct order have been obtained for the dissociation consts. of alkali halides. W. R. A.

Thermodynamic study of bivalent metal halides in aqueous solution. II. Activity coefficients of calcium, strontium, and barium chlorides at 25°. J. R. I. Hepburn and J. E. Garside (*Trans. Faraday Soc.*, 1941, **37**, 473—476).—The paper by Robinson (A., 1940, I, 359) bearing this title contains no reference to an earlier paper by Hepburn (A., 1932, 573) in which the same ground is covered and the same general conclusions are reached. Reasons are given in favour of using the experimental data of Lovelace *et al.* (A., 1921, ii,

239) for aq. KCl as a basis for calculating the abs. v.p. of other solutions from results of isopiestic measurements.

F. L. U.

Heterogeneous equilibria in the ammonia-nitrogen system at high pressure. I. Kritschewski and P. Bolschakov (*Acta Physicochim. U.R.S.S.*, 1941, 14, 353—364).—In the system $\text{NH}_3\text{--N}_2$ there is a two-phase region at temp. $>90^\circ$ and at pressures >1500 kg. per sq. cm. The crit. point is at $53\text{--}57$ vol.-% NH_3 , and is 1500 kg. per sq. cm. at 90° and 5500 kg. per sq. cm. at 125° . The crit. curve, starting from the val. for pure NH_3 , tends towards lower temp. at first but reaches a min. at $85\text{--}90^\circ$ and subsequently rises. The system shows a barotropic phenomenon; e.g., at 90° and <1800 kg. per sq. cm. the phase rich in NH_3 is the denser, but at >1800 kg. per sq. cm. it is the lighter. The possibility of limited mutual solubility in gases is discussed thermodynamically.

F. J. G.

Equilibrium of co-existing liquid and gas phases in the binary system methane-ethylene. L. M. Volova (*J. Phys. Chem. Russ.*, 1940, 14, 268—276).—Vals. arc recorded for the distribution of CH_4 between liquid and gas phases between 127° and 253° K. Above 190° K. only mixtures containing much C_2H_4 were examined. Hildebrand's equation for regular solutions of two substances having different mol. vols. can be applied to the system.

J. J. B.

Composition of the vapours of equimolecular mixtures. V. Kirev (*Acta Physicochim. U.R.S.S.*, 1940, 13, 454—466).—On the assumption that the max. or min. heat of mixing of liquids occurs when approx. equimol. quantities are used, it is shown that in binary mixtures in which no electrolytic dissociation occurs and under conditions such that the vapours obey approx. the ideal laws, the mol. fraction of one component in the vapour of an equimol. mixture follows closely the ideal law $m'' = p_b/(p_a + p_b)$. The variation of the vapour composition in an equimol. mixture with change in temp. is given by $dm''/m''(1 - m'') = (L_b - L_a)dT/RT^2$, where L_a and L_b are the mol. latent heats of the components in the free state. The rules are confirmed by experimental data.

J. W. S.

Vapour pressure of solutions of fluorosilicic acid. V. S. Jatlov and E. N. Pinaevskaja (*J. Appl. Chem. Russ.*, 1941, 14, 11—13).—The v.p. of SiF_4 is $>$ that of HF over solutions of H_2SiF_6 at temp. $<$ the b.p., to a degree diminishing with increasing $[\text{H}_2\text{SiF}_6]$. The partial pressures of HF, SiF_4 , and H_2O are recorded, for concns. of H_2SiF_6 $\geq 0.23\%$, at 50° , 75° , and 100° .

R. T.

Dissociation pressure of monocalcium orthophosphate crystal hydrate. A. M. Sorokin (*J. Appl. Chem. Russ.*, 1941, 14, 14—18).—The v.p. P of H_2O over $\text{Ca}(\text{H}_2\text{PO}_4)_2 \cdot \text{H}_2\text{O}$ at $40\text{--}90^\circ$ is expressed by $\log P = k/\theta$. The heat of hydration of $\text{Ca}(\text{H}_2\text{PO}_4)_2$ is 1.824 kg.-cal.

R. T.

Stratification in the ternary systems allylthiocarbimide-sulphur-amines. E. F. Shuravlev (*J. Gen. Chem. Russ.*, 1940, 10, 1926—1938).—Regions of stratification have been determined for the systems $\text{CH}_3\text{CH}_2\text{CH}_2\text{NCS--S--o-toluidine}$ (120° and 140°), --NPhMe_2 (80° , 90° , 100° , 110° , and 120°), and --NHPhMe (100° , 110° , 120° , 130° , and 140°).

R. T.

Ternary system toluene-*m*-xylene-naphthalene. V. M. Kravtchenko (*J. Phys. Chem. Russ.*, 1940, 14, 248—252).—This system forms an eutectic at -104.2° , C_{10}H_8 2, PhMe 79, *m*-xylene 19 mol.-%. The position of the eutectic point can be approx. calc. assuming the solution to be ideal.

J. J. B.

Application of the method of sections to determination of equilibria in ternary systems with solid phases. R. V. Mertzin and I. L. Krupatkin (*J. Gen. Chem. Russ.*, 1940, 10, 1999—2004).—*n*-composition curves are given for the system $\text{Pb}(\text{NO}_3)_2\text{--NaNO}_3\text{--H}_2\text{O}$, at 15° , and the results are treated geometrically, by the "method of sections" (Mertzin, *Bull. Res. Inst. Perm Univ.*, 1937, 2, 1). The compositions of the solid phases and solutions in contact with them are thus derived.

R. T.

Dehydration of molten carnallite. J. E. Vilnianski and N. P. Golubtschenko (*J. Appl. Chem. Russ.*, 1941, 14, 39—45).—The b.p. of fused carnallite falls from 715° to 516° as the $[\text{H}_2\text{O}]$ of the salt rises from 0.12 to 0.51%. The composition of the vapour phase over the fused salt varies according to the temp. and the H_2O content of the salt; the equilibrium coeff. is given by $K = [\text{HCl}]^2/[\text{MgCl}_2][\text{H}_2\text{O}]$.

R. T.

Ternary systems. VH. Sodium phthalate-sodium carbonate-water. S. B. Smith and E. I. Hoegberg (*J. Amer. Chem. Soc.*, 1941, 63, 1866—1869).—The solubility relations between Na phthalate (I), Na_2CO_3 , and H_2O have been determined at 25° , 30° , 33° , and 40° . No compound or solid solution is formed between (I) and Na_2CO_3 . (I), $7\text{H}_2\text{O}$ and $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$, $\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$, and $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$ have been found as solid phases and the composition of solutions at the quintuple point and the transition temp. at the quintuple point have been determined.

W. R. A.

Equilibria of manganese hydroxide, $\text{Mn}(\text{OH})_2$, in solutions of hydrochloric acid and sodium hydroxide. R. K. Fox, D. F. Swinehart, and A. B. Garrett (*J. Amer. Chem. Soc.*, 1941, 63, 1779—1782).—The solubility of $\text{Mn}(\text{OH})_2$ in H_2O , in HCl, and in NaOH has been determined at 25° and from the data it is concluded that $\text{Mn}(\text{OH})_2$ is a strong base reacting in acid solution $\text{Mn}(\text{OH})_2 + 2\text{H}^+ = \text{Mn}^{2+} + 2\text{H}_2\text{O}$ (i) and in basic solution $\text{Mn}(\text{OH})_2 + \text{OH}^- = \text{HMnO}_2' + \text{H}_2\text{O}$. The solubility product const. from (i) is 1.6×10^{-13} whilst that from solubility in H_2O is 2.8×10^{-13} . The ion product of the acidic dissociation $\text{Mn}(\text{OH})_2 = \text{H}^+ + \text{HMnO}_2'$ is 1×10^{-10} . Corresponding vals. of ΔG_{298}° have been calc.

W. R. A.

Sodium arsenites: system $\text{Na}_2\text{O--As}_2\text{O}_3\text{--H}_2\text{O}$ at 35° . O. A. Nelson (*J. Amer. Chem. Soc.*, 1941, 63, 1870—1872).—Two new Na arsenites, $\text{Na}_2\text{O} \cdot 3\text{As}_2\text{O}_3$ and $2\text{Na}_2\text{O} \cdot 3\text{As}_2\text{O}_3 \cdot 7\text{H}_2\text{O}$, have been revealed but the existence of $5\text{Na}_2\text{O} \cdot 2\text{As}_2\text{O}_3 \cdot 26\text{H}_2\text{O}$ has not been substantiated (cf. A., 1917, ii, 206). The behaviour of different arsenites with H_2O has been discussed.

W. R. A.

Necessary and sufficient number of sections for the construction of univariant curves in ternary and quaternary systems. D. Petrov (*Acta Physicochim. U.R.S.S.*, 1941, 14, 387—402).—It is shown by geometrical reasoning that in systems consisting of eutectics without solid solutions or compounds it is necessary and sufficient for the construction of the univariant curves to determine only three sections of a ternary, or six sections of a quaternary, system.

F. J. G.

Application of the co-node method to the determination of univariant curves for ternary and quaternary eutectic mixtures with mixed crystals. D. A. Petrov (*Acta Physicochim. U.R.S.S.*, 1941, 14, 497—502).—The method described in the previous abstract is extended to systems with mixed crystals.

F. L. U.

Possible errors in determination of the heat of formation of cuprous sulphide. I. A. Korschunov (*J. Phys. Chem. Russ.*, 1940, 14, 134—136).— ΔH for the formation of $\alpha\text{-Cu}_2\text{S}$ from Cu heated in H_2 and then in N_2 , and rhombic S, is $-19,300 \pm 500$ g.-cal. at 25° . This val. is less probable than $-18,500$ g.-cal. from electrochemical measurements.

J. J. B.

Heat of formation of silver sulphide. A. F. Kapustinski and I. A. Korschunov (*J. Phys. Chem. Russ.*, 1940, 14, 131—133).—Ag powder treated with H_2 combines with rhombic S so rapidly after being ignited with a hot wire that the heat of formation of Ag_2S can be measured directly. $\Delta H = -7560 \pm 350$ g.-cal. at 25° .

J. J. B.

Standard free energies of formation of metallic sulphides from e.m.f. I. A. Makolkin (*Acta Physicochim. U.R.S.S.*, 1940, 13, 361—368).—The e.m.f. of the cells $\text{Pt}[\text{H}_2(1 \text{ atm})]|\text{KCl}(0.01N.)|\text{KCl}(0.01N.)|\text{H}_2\text{S}(1 \text{ atm})|\text{CdS}$ or ZnS or MoS_2 have been measured at 25° and the following thermodynamic vals. for the formation of the sulphides are evaluated; $\Delta G_{298.1^\circ}^\circ$: $\text{CdS} -32,970$, $\text{ZnS} -46,730$, and $\text{MoS}_2 -53,960$ g.-cal. per g.-mol., $\Delta H_{298.1^\circ}^\circ$: $\text{CdS} -34,000$, $\text{ZnS} -47,860$, and $\text{MoS}_2 -55,930$ g.-cal. per g.-mol., $\Delta S_{298.1^\circ}^\circ$: $\text{CdS} -3455$, $\text{ZnS} -3790$, and $\text{MoS}_2 -6608$ entropy units per g.-mol.

J. W. S.

Heat of reaction of sulphur with lead and tin. I. A. Korschunov (*J. Gen. Chem. Russ.*, 1940, 10, 2087—2090).—The heat of formation of PbS is -22.38 , of SnS -18.61 , of PbMg_2 -42.0 , and of SnMg_2 -48.0 kg.-cal. per g.-mol.

R. T.

Partial pressure of hydrogen bromide over its solution in benzene and heat of dissolution of hydrogen bromide in benzene. A. F. Kapustinski and V. A. Maltzev (*J. Phys. Chem. Russ.*, 1940, 14, 105—109).—The v.p. of HBr rises linearly with its molarity: at 30° from 0.01003 to 0.7455 atm. for 0.000612M. to 0.04713M., and at 50° from 0.1667 to 0.8325 atm. for 0.00686 to 0.03418M. These results agree

neither with Raoult's law nor with Hildebrand's rule. For the heat of dissolution 4197 g.-cal. per mol. is calc.

J. J. B.

Thermodynamics of the manganese ion. Entropy of aqueous ions. A. F. Kapustinski (*Acta Physicochim. U.R.S.S.*, 1941, 14, 503—522).—The heat of dissolution of cryst. MnCO_3 in 1M-HCl to give 0.05M- MnCl_2 , and the heat of dilution of 1M- to 0.05M- MnCl_2 , were measured at 20°, giving $\Delta H_{298} = -3.68 \pm 3.5\%$ kg.-cal. for the reaction $\text{MnCO}_3 (\text{cryst.}) + 2\text{HCl} (1\text{M.}) = \text{MnCl}_2 (1\text{M.}) + \text{CO}_2 (\text{gas}) + \text{H}_2\text{O} (\text{liquid})$. This result, combined with known vals. of other necessary quantities, leads to $\Delta H = -207.8 \pm 1\%$ cal. for $\text{Mn} (\text{cryst.}) + \text{C} (\text{graphite}) + 1.5\text{O}_2 (\text{gas}) = \text{MnCO}_3 (\text{cryst.})$, and $\Delta H = -49.13$ cal. for $\text{Mn} (\text{cryst.}) = \text{Mn}^{++} (1\text{M.})$. The entropy of the hydrated Mn ion at 298.1° K. is calc. to be 19.1 ± 0.6 units. Theoretical considerations about aq. ions in general lead to the conclusions (a) that the entropy of ions of equal dimensions is a linear function of the ionic charges, and (b) that the entropy of ions of equal valency is a linear function of the reciprocal of the ionic radius. These rules are applied to calculate the entropies of other ions for which the radii are known.

F. L. U.

VII.—ELECTROCHEMISTRY.

Dispersion of current in solutions. N. A. Schpigel (*J. Gen. Chem. Russ.*, 1940, 10, 2077—2086).—In general, for dil. solutions, increase in conductivity κ with increasing vol V of solution may be expressed by the formula $\kappa/\kappa_0 = (\phi - 1)/(a + b\phi)$, where $\phi = V/V_0$, and a and b are const. Scatterings of current in conc. solutions is $<$ in dil. ones.

R. T.

Antimony electrode. F. Hovorka and G. H. Chapman (*J. Amer. Chem. Soc.*, 1941, 63, 2024).—Correction (cf. A., 1941, I, 268).

W. R. A.

Metastability of cadmium sulphate and its effect on the e.m.f. of saturated standard cells. G. W. Vinal and L. H. Brickwedde (*J. Res. Nat. Bur. Stand.*, 1941, 26, 455—465).—Solubility and e.m.f. measurements indicate that the transition point between $3\text{CdSO}_4 \cdot 8\text{H}_2\text{O}$ (I) and $\text{CdSO}_4 \cdot \text{H}_2\text{O}$ (II) is 43.4°. The solubility of (I) increases, and that of (II) decreases, with rise of temp. The temp. coeff. of the Cd amalgam(I) electrode is negative, and that of the Cd amalgam(II) electrode is positive. Both forms tend to persist in a metastable state. The thermodynamics of the interchange are discussed.

J. W. S.

Derivation of expressions for the e.m.f. of concentration cells from the principle of the Donnan membrane equilibrium. S. G. Chaudhury (*J. Proc. Inst. Chem. India*, 1941, 13, 62—80).—By applying the Donnan principle and Boltzmann's distribution law to the liquids (double layer plus bulk solution) surrounding two reversible electrodes, equations identical with those generally used are derived for the e.m.f. of concn. cells with transference.

F. L. U.

Decomposition potentials of salts in liquid ammonia. A. Murtazaev and I. Abljaev (*J. Phys. Chem. Russ.*, 1940, 14, 69—72).—Decomp. potentials in NH_3 at 0° for n. solutions are: NaNO_3 2.52, KI 2.87, KBr 2.43, NH_4NO_3 1.34, NH_4Cl 1.07, and NH_4Br 0.92 v. They are $>$ in H_2O for Na and K salts, and $<$ in H_2O for NH_4 salts, since NH_4 salts in NH_3 are acids.

J. J. B.

Photogalvanic processes on a silver electrode. V. I. Veselovski (*Acta Physicochim. U.R.S.S.*, 1941, 14, 483—496).—Ag covered with Ag_2O , when immersed in dil. alkali and illuminated, acquires a stable negative potential with respect to that of a similar electrode in the dark. The max. effect is in the red region and is attained in a fraction of a sec. The relations between the effective (measured) and true vals. of the e.m.f. and the max. current are established, and the latter is obtained as the product of the estimated capacity, 640 μF . per sq. cm., and the rate of change of potential (from oscillograms) near the beginning of the charging process; with the illumination used and the electrode in 0.1N-NaOH $I_{\text{max.}} = 25.6 \mu\text{A}$. per sq. cm. of apparent surface. Measurements of the true photogalvanic current for different times of anodic polarisation, with an electrode illuminated by monochromatic light of const. intensity, indicate a quantum yield approaching 1 for sufficiently large positive vals. of the potential.

F. L. U.

Polarisation during the electrolytic reduction of titanium ions. O. Essin (*Acta Physicochim. U.R.S.S.*, 1940, 13, 429—442).—When solutions of low $[\text{Ti}^{IV}]$ are electrolysed using flowing Hg electrodes, the anodic polarisation increases steadily at first with increasing current, and then increases slowly as the current approaches its saturation val. The cathodic polarisation curve, however, shows two distinct branches attributed to the transitions $\text{Ti}^{IV} \rightarrow \text{Ti}^{III}$ and $\text{Ti}^{III} \rightarrow \text{Ti}^0$, respectively. It is shown that both processes are accompanied by slow discharge complicated by an inadequate rate of diffusion of ions and retarded dissociation, particularly of complex Ti^{IV} ions. It is suggested that the existence of an electrolytic saturation current influences the form of the voltage-current curve for the reduction of Ti, but its calc. magnitude is $>$ the saturation c.d. observed.

J. W. S.

Polarisation capacity of a smooth gold electrode. G. Deborin and B. Erschler (*Acta Physicochim. U.R.S.S.*, 1940, 13, 347—360).—By the capacity method (cf. A., 1938, I, 624) it has been shown that after Au has been heated in air at 900° ~ 4 at. layers of O_2 are bound on its surface. The cathodic potential required to remove this layer in acid solutions is $>$ in basic solutions. Charging curves for a smooth Au electrode in N- H_2SO_4 , -HCl, and -KOH have been obtained. Preliminary oxidation of the Au causes distortion of the shape of the charging curves, attributed to firmly bound O_2 , which appears not to be removed on subsequent cathodic polarisation of the electrode up to the reversible H potential. During anodic polarisation of a Au electrode which has been cleaned from the firmly bound O_2 0.5—1 at. layer of O is taken up. This O is less easily deposited and more easily removed in bases than in acids.

J. W. S.

Hydrogen overvoltage at high current densities. V. Decay of hydrogen overvoltage. A. Hickling and F. W. Salt (*Trans. Faraday Soc.*, 1941, 37, 450—462).—An improved interruptor circuit is described which permits observation of the decay of overvoltage (η) from a min. time of 5×10^{-6} sec. Measurements with cathodes of 18 different materials show the occurrence of two distinct processes, one of which, operative at c.d. $> 10^{-3}$ amp. per sq. cm., leads to a rapid fall of potential in 10^{-3} sec., and depends mainly on the magnitude of the polarising c.d. The other process, operative at all c.d. vals., results in a slower decay of η which, after a time that decreases with increase of the polarising c.d., becomes $\propto \log$ time; the rate of decay then depends only on the electrode material. None of the theories of overvoltage so far proposed is capable of explaining the observations.

F. L. U.

Overvoltage of hydrogen on nickel in acid solutions. A. Legran and S. Levina (*J. Phys. Chem. Russ.*, 1940, 14, 211—216).—Overvoltage (η) is independent of c.d. (i) when i is $< 10^{-6}$ amp. per sq. cm. At higher c.d. $\eta = a + b \log i$; b is 0.093 in dil. solutions and rises to 0.103 in conc. solutions. The vals. of η are identical in HCl, HBr, and H_2SO_4 ; they increase with dilution between 0.01N. and 1N. and are independent of it at lower concns. La salts slightly reduce η at low i vals. and mostly raise it slightly at higher i . At higher i the overvoltage is due to a retardation of H^+ discharge but its mechanism at low i is obscure.

J. J. B.

Use of dropping mercury electrode for measuring overvoltage. Z. A. Iofa and A. N. Kolitschev (*J. Phys. Chem. Russ.*, 1940, 14, 58—68).—For the coeff. b in the equation $b = d\eta/d \log i$, η being the overvoltage and i the c.d., different vals. were obtained when using stationary and dropping electrodes (cf. Heyrovsky, A., 1937, I, 525). This discrepancy disappears if (a) the variation of the surface tension and, therefore, of the drop vol. with the applied potential is considered; this correction eliminates the apparent rise of b at high vals. of i ; (b) the current used up for charging the growing drop is subtracted from the observed i ; this correction eliminates the abnormally low vals. of b at low i ; and (c) i is referred to the average surface area of the drop which fluctuates between a very small and a max. val. $b = 4.6 RT/F$ for both stationary and dropping electrodes. The experiments were carried out in 0.01—6.5N-HCl and in 1—5.5N-HBr.

J. J. B.

Corrosion of lead in an oxidising medium. E. V. Krivopalova and B. N. Kabanov (*J. Phys. Chem. Russ.*, 1940, 14, 279).—The polarisation of Pb in 7N- H_2SO_4 at 0.2 ma. per sq. cm. and its depolarisation in 1N- Na_2SO_4 at 20 ma. per sq. cm. are studied by potential measurements. In addition to potentials

corresponding with the reactions $\text{PbO}_2 \rightarrow \text{PbSO}_4$ and $\text{PbSO}_4 \rightarrow \text{Pb}$ another potential is noticed which is presumably due to decomp. of a compound between PbO_2 and PbSO_4 . Stearic acid and HCl strongly increase the anodic corrosion of Pb ; octoic acid, palmitic acid, AcOH , and NiSO_4 are less effective. 0.1% CoSO_4 lowers the corrosion by 50% and increases the life of accumulators. J. J. B.

Electrochemical properties of mineral membranes. I. Estimation of potassium ion activities. C. E. Marshall and W. E. Bergman (*J. Amer. Chem. Soc.*, 1941, 63, 1911—1916).—The electrochemical behaviour of apophyllite (I) and montmorillonite (II) membranes to K^+ ions has been investigated. (I) proved unsuitable, but with membranes of (II), particularly if dried at $>200^\circ$, reproducible results were obtained. The effect of the anion on the determination of K^+ ion activities has been investigated and membrane potentials in the presence of bivalent cations have been measured. At $<0.1\text{N}$, K^+ ion activities can be determined within 5%. W. R. A.

VIII.—REACTIONS.

Mechanism of two-stage ignition. D. A. Frank-Kamenetzki (*J. Phys. Chem. Russ.*, 1940, 14, 30—35).—Reactions the rate of which increases to ignition, decreases, and then rises to a second ignition (cf. Belov and Neumann, A., 1938, I, 256) can take place if $dx/dt = k_1ax - k_2xy$ and $dy/dt = k_3xy - k_4ay$, a , x , and y being the concns. respectively of the combustible substance A , of an intermediate product X formed from A , and of another intermediate product Y originating from X . In combustion of hydrocarbons the product X is probably a per-acid, and Y an aldehyde. J. J. B.

Carbon monoxide-oxygen flame. VII. The OH radical in the flame of moist carbon monoxide. E. Kondratieva and V. Kondratieva (*J. Phys. Chem. Russ.*, 1940, 14, 1—5).—A mixture of CO 15.5, O_2 15.5, and H_2O 0.5 mm. Hg was passed through a quartz tube at 690° . The selective absorption of the radiation 3064 μ showed that the pressure of OH was 0.004 mm. This concn. is 100 times the equilibrium $[\text{OH}]$ at the temp. of the flame (810°). OH is produced in a chemical reaction and consumed by oxidation of CO. J. J. B.

Ignition temperatures of acetylene-air and acetylene-oxygen mixtures. G. W. Jones and W. E. Miller (*U.S. Bur. Mines*, 1941, Rept. Invest. 3567, 5 pp.).—Data on the ignition temp. of air- C_2H_2 mixtures over a wide range of composition, and also of O_2 - C_2H_2 mixtures having a high % of C_2H_2 , are given. The ignition temp. of air- C_2H_2 mixtures depends markedly on the composition, decreasing rapidly as the % of C_2H_2 increases up to $\sim 30\%$, when it becomes const. at $\sim 305^\circ$. F. J. G.

Dependence of the induction period of acetaldehyde cool flame on the composition of the mixture. N. P. Keyer and M. B. Neumann (*Acta Physicochim. U.R.S.S.*, 1941, 14, 451—462).—The cool flame induction period τ is related to the composition of the mixture by $\tau = (k_1[\text{O}_2]^2 + k_2)/k_3[\text{MeCHO}]^2[\text{O}_2]^2$. This expression is deducible from the authors' theory of the mechanism of the reaction (cf. A., 1941, I, 340) and its correctness is established by experiments over the temp. range 231 — 265° . The oxidation of MeCHO is an example of a chain reaction with degenerate branching which occurs on triple collisions between AcO_2H mols. and those of MeCHO and O_2 . F. L. U.

Cold and hot flame of ethyl ether. K. I. Ermakova (*J. Phys. Chem. Russ.*, 1940, 14, 148—156).—The pressure in Et_2O -air and Et_2O - O_2 mixtures varies in the course of their slow combustion in six different ways according to temp. and concn. of the mixtures. The boundaries of the six regions are determined; for the mixture $\text{Et}_2\text{O} + \text{O}_2$ the regions of cold flame are confined between 10 and 140 mm. Hg and between 170° and 320° . In one of the regions the induction period of ignition can be measured; it decreases when pressure and temp. increase. J. J. B.

Explosive properties of nitrogen trichloride. A. J. Apin (*Acta Physicochim. U.R.S.S.*, 1940, 13, 405—422).—In the absence of air NCl_3 undergoes spontaneous decomp. with the emission of light at all pressures $<$ a definite upper limit (40, 70, and 115 mm. at 20° , 40° , and 60° , respectively). The decomp. is propagated by local explosions. The ignition is accelerated by an unstable active intermediate compound,

some of which remains in the vessel after decomp. is apparently complete. Liquid NCl_3 in fused glass bulbs heated at 60° explodes after an average time of 13 sec., but at 55° no explosion occurs. Dilution with the decomp. products raises the temp. of the explosion. Below the explosion temp. liquid NCl_3 decomposes slowly. The mechanism of the explosion of NCl_3 and of $\text{NH}_3\cdot\text{NI}_3$ is discussed. J. W. S.

Combustion of nitroglycerol. A. F. Belaiev (*Acta Physicochim. U.R.S.S.*, 1941, 14, 523—546).—Experiments with $(\text{CH}_2\text{O}\cdot\text{NO}_2)_2$ are described in support of the author's theory of explosions (cf. B., 1939, 554, 781). The calc. temp. of combustion is 1350° . The relations between rate of combustion and the kinetic consts. of the reaction, calc. with the equations of Zeldovitch and Frank-Kamenetzki (A., 1938, I, 625), are in accord with observation. F. L. U.

Quantitative studies of the oxidation of fatty acids by hydrogen peroxide.—See A., 1941, I, 278.

Kinetics of the polymerisation of $\Delta^{\alpha,\gamma}$ -butadiene in presence of potassium phenylisopropyl. O. Mamontova, A. Abkin, and S. Medvedev (*J. Phys. Chem. Russ.*, 1940, 14, 36—48).—The rate of polymerisation was determined from the reduction of vol. of gaseous $(\text{CH}_3\text{CH})_2$ (I) over a solution of $\text{K}\cdot\text{C}_6\text{H}_5\text{Pr}^i$ (II) in Et_2O , the pressure p of (I) being kept const. When p increased (between 540 and 620 mm. Hg), the rate increased at first slowly, then rapidly, and then again slowly; the highest rate at 25° was about 6 c.c. of gas per min. and per c.c. of solution. The effect of the concn. of (II) (between 10^{-3} and $6 \times 10^{-2}\text{N}$) was indefinite. An increase of the surface area of glass in contact with solution raised the rate but $<$ proportionately to the area. From measurements at 5° , 15° , and 25° the activation energy was calc. to be 7600 g.-cal. The reaction chains probably started at the surface, grew in the bulk of solution, and broke down both at the surface and in the bulk. Saturated solutions of (I) in Et_2O are 0.3M. and 0.73M. at $p_{\text{H}_2} = 572$ and 637 mm. Hg respectively. J. J. B.

Chemical warfare materials. XXIII. Hydrolysis of $\beta\beta'$ -dichlorodiethyl sulphide. H. Mohler and J. Hartnagel (*Helv. Chim. Acta*, 1941, 24, 564—570).—The velocity of hydrolysis of $(\text{Cl}\cdot\text{CH}_2)_2\text{S}$ by H_2O is independent of p_{H} , and is greatly diminished in aq. alcohols, confirming the view that the measured rate is that of ionisation of the Cl. The energy of activation is ~ 17.5 kg.-cal. The rate is not appreciably affected by the presence of metallic salts. F. J. G.

Exchange reaction between gaseous and combined nitrogen. Y. Nishina, T. Iimori, H. Kubo, and H. Nakayama (*J. Chem. Physics*, 1941, 9, 571—572).—By leaving radioactive $^{13}\text{N}_2$, prepared by bombarding amorphous C with deuterons from a cyclotron, in contact with 0.025—0.1M. solutions of NaNO_2 , NaNO_3 , NH_2OH , HCl , NH_4Cl , KCN , N_2H_4 , H_2SO_4 , $\text{Na}_2\text{Co}(\text{NO}_2)_6$, 8-hydroxyquinoline acetate, and $\text{CO}(\text{NH}_2)_2$ and, after removing the gas, pptg. the N from solution, it has been shown that interchange occurs between the N_2 and N compound. With NaNO_2 the rate of interchange decreases with increasing $[\text{NaNO}_2]$ and becomes undetectable in 2M. solution. J. W. S.

Halogenation of phenolic ethers and anilides.—See A., 1941, II, 287.

Oxidation with molecular oxygen. III. Kinetics of the autoxidation of protected blue cobalt hydroxide. W. Feitknecht [with W. Bédert] (*Helv. Chim. Acta*, 1941, 24, 694—702).—The kinetics of the oxidation by O_2 of blue $\text{Co}(\text{OH})_2$, stabilised by glucose, have been studied. At const. p_{O_2} , the course of reaction is represented by $dx/dt = k(a-x)^{2.65}$. The curves of k against p_{O_2} resemble adsorption isotherms. The temp. coeff. is small, corresponding with an apparent activation energy of 9 kg.-cal. It is concluded that the reaction depends on activation of O_2 by adsorption. F. J. G.

Oxidation of isomeric ketones by selenium dioxide.—See A., 1941, II, 281.

Oxidation of substituted acetophenones with selenium dioxide.—See A., 1941, II, 323.

Velocity of high-temperature reactions. I. Kinetics of reduction of magnesium oxide by various reagents. A. S. Mikulinski. II. Reduction of phosphorites. A. S. Mikulinski and F. S. Maron (*J. Appl. Chem. Russ.*, 1941, 14, 19—29, 30—38).—I. The temp. of initiation, θ , of the reaction between MgO and various reducing agents varies parallel with pres-

sure. In high vac. (<1 mm.) the vals. of θ are: C 1380°, CaC₂ 1290°, Al 1200°, Fe-Al 1210°, Fe-S 1330°.

II. The velocity of the reaction $\text{Ca}_3(\text{PO}_4)_2 + 3\text{SiO}_2 + 5\text{C} \rightarrow 3\text{CaSiO}_3 + \text{P}_2 + 5\text{CO}$ is inversely \propto diameter of the granules of substrates. The reaction is completed in 17 min. at 1400–1450° when the granule diameter is 2–3 mm., and in 120 min. when this is 7–14 mm. R. T.

Kinetics of dissociation of pyrites. V. S. Udintzeva and G. I. Tschufarov (*J. Appl. Chem. Russ.*, 1941, 14, 3–10).—The velocity of the reaction $\text{FeS}_2 \rightleftharpoons \text{FeS} + \text{S}$ is, within certain limits, \propto temp., and inversely \propto diameter of the granules and to the pressure. No induction period could be detected. The rate of advance of the reacting surface within each granule is const. until ~70% of the mass has reacted. At 525° the rate of decomp. of mono-crystal is 300 times < of poly-crystal granules. R. T.

Mechanism of catalytic reactions of halogens and their derivatives. I. Kinetics of the catalytic displacement of hydrogen in benzene. N. E. Breshneva and S. Z. Roginski (*J. Phys. Chem. Russ.*, 1940, 14, 49–57).—The initial rate of consumption of Br in a solution of Br and ZnBr_2 in C_6H_6 or in $\text{C}_6\text{H}_6\text{--Et}_2\text{O}$ at 60° $\propto [\text{ZnBr}_2][\text{C}_6\text{H}_6][\text{Br}_2]$, when $[\text{ZnBr}_2]$ varies from 1 to 30 g., [Br] from 3 to 18 g., and $[\text{C}_6\text{H}_6]$ from 25 to 100 c.c. per 100 c.c. of solvent. In later stages the apparent reaction coeff. decreases. This decrease is due to an inhibition by PhBr; in a mixture of C_6H_6 15, PhBr 85 the reaction is 15–150 times as slow as in a mixture of C_6H_6 15, amyl ether 85 and is strictly unimol. After correction for the effect of PhBr the reaction coeff. is 1.5×10^{-2} , 6×10^{-4} , and 3.3×10^{-4} at 80°, 60°, and 40°, respectively; the activation energy is 8000 g.-cal. The inhibiting effect of PhBr is probably due to formation of a complex with ZnBr_2 . J. J. B.

Oxidation with molecular oxygen. I. W. Feitknecht (*Helv. Chim. Acta*, 1941, 24, 670–675).—Oxidation by mol. O_2 (autoxidation) is discussed and a no. of theories are summarised and compared. It is suggested that in the oxidation of a solid phase, or of a dissolved substance in presence of a solid catalyst, the first stage is activation of O_2 by adsorption. For testing this theory, instances in which the oxidation of a solid proceeds without a change of phase, i.e., through a continuous series of solid solutions, are particularly suitable. Examples of this kind are the first stages of the oxidation of the green basic Co salts and of blue $\text{Co}(\text{OH})_2$. F. J. G.

Order of reactions of hydrogenation and dehydrogenation. M. A. Grechnev and I. G. Eroschevski (*J. Gen. Chem. Russ.*, 1940, 10, 2005–2013).—Reactions of hydrogenation or dehydrogenation in presence of excess of catalyst may be of the first, second, or third order. If only a small proportion of substrate is in contact with the active centres of the catalyst at any given moment, or if the reaction is a slow one, it will be apparently of zero order. If the reaction at these centres is very fast, it will be of the first order. These considerations are illustrated by the reactions of dehydrogenation of borneol and isoborneol at a C–Cu catalyst. R. T.

Velocity of decomposition of hydrocarbons during destructive hydrogenation. I. Naphthalene, tetra- and deca-hydronaphthalene, and dodecane. A. V. Lozovoi and S. A. Senjavin (*J. Appl. Chem. Russ.*, 1941, 14, 96–109).—The hydrocarbons were hydrogenated at 360–475°/180–220 atm. (MoS_2 catalyst). The velocities of hydrogenation were, taking that of tetrahydronaphthalene (I) as 1: $n\text{-C}_{12}\text{H}_{22}$, 56.8, decahydronaphthalene 2-2, C_{10}H_8 , 0.27. Hydrogenation of C_{10}H_8 involves the reactions $\text{C}_{10}\text{H}_8 \rightarrow \text{I}$ (rapid reaction) $\rightarrow \text{PhBu}$ (slow) $\rightarrow \text{PhMe}$ and PhEt (rapid) $\rightarrow \text{C}_6\text{H}_6$. R. T.

Kinetics of the para-ortho transformation of hydrogen on charcoal. R. Burshtein (*J. Phys. Chem. Russ.*, 1940, 14, 157–160).—The half-val. time of the p - o -transition of H_2 at 90° K. in presence of well (950°) degassed charcoal \propto the amount of H_2 . When charcoal after being degassed at 950° was allowed to adsorb at 500° 0.2 c.c. of H_2 per g., the half-val. time became, except at pressures <4 mm. Hg, independent of the amount of H_2 and \gg that on pure charcoal. The H_2 adsorbed at 500° poisoned the active centres of charcoal; on the remaining surface the reaction was of the first instead of zero order. J. J. B.

[Catalytic] synthesis of benzene hydrocarbons from methane.—See B., 1941, II, 325.

Activation of ammonia synthesis by means of alkali ions.—See B., 1941, I, 443.

Catalytic vapour-phase oxidation of aliphatic kerosene fractions.—See B., 1941, I, 435.

Electrolytic replacement of sodium by ammonium in glass.—See B., 1941, I, 450.

Lead oxides. III. Radioactive indicator method applied to the lead storage cell.—See B., 1941, I, 419.

Formation of nitrogen oxides in a torch discharge of an ultra-high frequency. P. A. Serebriakov (*J. Phys. Chem. Russ.*, 1940, 14, 175–179).—A torch discharge occurs when a high-frequency current (~10⁷ cycles) passes through a needle electrode in air at atm. pressure. The min. voltage required for lighting is 1000–1500 v.; then the torch burns also at 600–800 v. The vol. of the torch \propto the no. of watts supplied, and the density of its energy is independent of the power W . When torch discharge takes place in streaming air, NO is produced. [NO] in the outgoing gas increases with W (30–140 w.) and decreases when the rate v of flow (9–250 l. per hr.) increases; [NO] as a function of W/v (i.e., of the energy spent per unit vol. of air) is independent of W . At low v it becomes also independent of v ; its val. then is 3%. The yield of NO is at 750–1100 mm. Hg > at 250–600 mm. The highest yield observed was 63 g. of HNO_3 per kw.-hr. J. J. B.

Photosensitisation by solids. II. Photosensitised oxidation of ammonia in aqueous solution with titanias as the photosensitiser. G. Gopal Rao and K. S. Murty (*Indian Chem. Soc.*, 1941, 18, 127–137).— NH_3 in aq. solution is oxidised on exposure to visible light in presence of TiO_2 . The reaction is of zero order, and with increasing amount of TiO_2 its rate at first increases linearly and then tends to reach a max. The rate increases with increasing p_{H} in the range 7.5–9.6, and is diminished by addition of electrolytes, the effect increasing in the order NaCl , BaCl_2 , AlCl_3 . NH_3 is strongly adsorbed from solution on ignited TiO_2 . The oxidation is rapid in light of λ 4050 Å., but slow in light of longer λ . The mechanism of the reaction is discussed. It probably involves activation of adsorbed NH_3 by an excited Ti^{+++} ion in the surface. F. J. G.

Photochemical primary process of ions in aqueous solutions. J. Weiss (*Trans. Faraday Soc.*, 1941, 37, 463–469).—The primary process in the case of I^{\cdot} , HS^{\cdot} , and RS^{\cdot} can be represented generally by $\text{X}^{\cdot}\text{H}_2\text{O} + h\nu = \text{X} + \text{H} + \text{OH}^{\cdot}$, and the observed effects of irradiating solutions of these ions under various conditions are adequately explained by taking into account secondary chemical processes. The energy required for these reactions, and for those of Fe^{\cdot} , Cr^{\cdot} , Ce^{\cdot} , and Co^{\cdot} , are calc. from the corresponding oxidation-reduction potentials. The thermal formation of H_2 from Fe^{II} solutions and of O_2 from Co^{III} solutions is discussed. F. L. U.

Efficiency in the primary photochemical process in solution. K. Atwood and G. K. Rollefson (*J. Chem. Physics*, 1941, 9, 506–512).—The quantum yield (η) in the photochemical decomp. of $(\text{COBr})_2$ in CCl_4 solution at 2650 Å. is ~0.9, approx. the same as in the gas phase, but it decreases with increasing λ , particularly between 3130 and 3650 Å., and becomes ~0.3 at 4358 Å. In the decomp. of NOCl in CCl_4 in presence of O_2 to prevent the back reaction η varies from 0.7 at 3650 Å. to 0.5 at 5790 Å., as compared with ~2 for all $\lambda\lambda$ in the gas phase. The results are discussed with reference to the Franck-Rabinovitch hypothesis and it is suggested that the lower vals. of η for the solutions are more probably due to deactivation by the solvent than to high efficiency of recombination. The equilibrium const. of the reaction $\text{N}_2\text{O}_4 \rightleftharpoons 2\text{NO}_2$ in CCl_4 solution at 25° is 6.4×10^{-5} (concns. in mol. fractions). J. W. S.

Application of electron microscope to the study of photographic phenomena. C. E. Hall and A. L. Schoen (*J. Opt. Soc. Amer.*, 1941, 31, 281–285).—Photographic emulsions have been examined by means of an electron microscope of resolving power <50 Å. Ag halide crystals exposed to the electron beam are at first opaque but on continued exposure develop holes and cracks due to migration of Ag^+ ; a stable state is finally reached. Ag crystals remain after treatment with $\text{Na}_2\text{S}_2\text{O}_3$. Latent image particles produced by exposure to light have not been identified. Developed Ag shows a filamentary structure; the length and thickness of the fila-

ments depend on the developer. Physical development and $p\text{-C}_6\text{H}_4(\text{NH}_2)_2$ produce massive clumps of Ag. Lippmann emulsions produce on development a long single filament from each particle. L. J. J.

Rebromination theory of photographic solarisation. J. H. Webb and C. H. Evans (*J. Opt. Soc. Amer.*, 1940, 30, 445—454).—The effect on the density-log exposure curves of three emulsions of exposure temp. from 58° to -196° has been investigated. With decreasing temp. the max. density val. decreases and below -73° the position of the max. shifts to longer exposures. At temp. $< -100^\circ$ the max. density val. increases and solarisation decreases until at -196° it disappears. Introduction of Br acceptors into the emulsion causes decrease in solarisation. Removal of AgBr from the film after exposure by immersion in dil. $\text{Na}_2\text{S}_2\text{O}_3$ decreases solarisation but on long immersion causes a decrease in max. density. The position of the max. in the solarisation curve is the same for chemical and physical development. With reduced intensity of illumination greater total exposures, exposure time \times intensity, are required to produce solarisation. These facts are interpreted as supporting the rebromination theory of solarisation. O. D. S.

Optical sensitisation of photographic emulsions. I. Rôle of adsorption in optical sensitisation. J. N. Gorochovski, A. A. Kriukov, and V. I. Fedotova. **II. Spectral properties of emulsions consisting of various silver halides.** J. N. Gorochovski, A. J. Smirnov, and V. I. Fedotova (*J. Phys. Chem. Russ.*, 1940, 14, 180—187, 188—194).—I. From the variation of the e.m.f. of cells $\text{Ag}|\text{dye solution}|\text{saturated KCl}|\text{Hg}_2\text{Cl}_2|\text{Hg}$ on addition of AgNO_3 to the dye solution it is concluded that erythrosin (I) forms a compound with Ag, pinaverdol iodide (II) ppts. AgI, and pinaflavol iodide and cryptocyanin iodide (III) first ppt. AgI and then affect AgNO_3 otherwise (? reduction). Adsorption of (I) by AgBr is lessened the more markedly by KBr the higher is [KBr], and adsorption of (II) and (III) is increased by KBr and reduced by AgNO_3 . Adsorption of pinacyanol (IV) is min. in absence of both KBr and AgNO_3 . Sensitisation is defined as the ratio of the photosensitivity in the point of max. sensitisation to the max. sensitivity of Ag halide emulsion; this ratio is strongly lowered by KBr for (I), but is almost independent of [KBr] up to 10^{-3}M . for (II), (III), and (IV). There is a similarity between the effect of KBr on adsorption of, and on sensitisation by, (I); this similarity is masked for (II), (III), and (IV) by their colloidal nature.

II. Sensitivity of emulsions of AgCl, AgBr, AgI, and their mixtures is determined for the region $>400\text{ m}\mu$. Mixtures of AgBr and AgI are more sensitive to long waves ($>450\text{ m}\mu$) than AgBr emulsions, especially if AgBr and AgI are pptd. together as distinct from being mixed after pptn. Sensitisation by (I), (III), and (IV) is equally strong for AgBr and AgBr 50, AgCl 50, but is reduced several times if the emulsion contains AgI. J. J. B.

Mechanism of the regeneration of dye in the course of the sensitised photolysis of silver halide. S. V. Natanson and G. L. Natanson (*J. Phys. Chem. Russ.*, 1940, 14, 278).—In absence of O_2 suspensions of Ag erythrosinate are decomposed by light giving Ag and decomp. products of erythrosin (I). If NaNO_2 , gelatin, or some other substances are added to the suspension, Ag is pptd. in light but (I) is not destroyed. It is suggested that (I) gives up an electron to Ag⁺ and then, if substances capable of giving electrons are present, obtains one from these. J. J. B.

Photochemistry of fluorescein dyes. G. L. Natanson (*J. Phys. Chem. Russ.*, 1940, 14, 16—29).—Uranin (I), eosin (II), and erythrosin (III) in air-free aq. solution are transformed by the visible light of a 2-kw. lamp into coloured products having absorption max. at $495\text{ m}\mu$. (I), $515\text{ m}\mu$. (II), and $520\text{ m}\mu$. (III). At 20° the transformation of (II) takes 10—100 hr. During the transformation the absorption spectrum changes in a complicated manner showing that >2 reaction products are formed. The solution contains Br⁻ [from (II)] or I⁻ [from (III)]. 10^{-3} — 10^{-1}N -NaOH reduces the transformation time of (II) to 1—10 hr.; the spectrum of the product has a max. at $500\text{ m}\mu$. Air increases the bleaching time in presence of NaOH and prevents formation of coloured products; the absorption of aq. solutions of (II) is lowered to the same extent along the whole spectrum. In this case the quantum yield is 1.5×10^{-4} . In presence of 0.2M - Na_2SO_3 (II) gives another dye. In presence of 0.3M -KI

(II) is not affected by visible light. Dry films of (II) are bleached by visible light rapidly when the air is dry (P_2O_5), slowly in moist air, not at all in vac. or in air-free H_2O vapour; hence H_2O_2 is not required for bleaching. No coloured compounds are formed when (II) is irradiated in COME_2 , EtOH, or $\text{C}_2\text{H}_5\text{N}$. J. J. B.

IX.—METHODS OF PREPARATION.

Salts of alkaloids with bromo-complexes of some heavy metals.—See A., 1941, II, 306.

Decomposition of alkali, calcium, and magnesium carbonates.—See B., 1941, III, 265.

Metallic contamination of hot water from cylinders of bare and tinned copper.—See B., 1941, I, 418.

Chlorination of barium sulphide solutions. V. M. Grinevitsch (*J. Appl. Chem. Russ.*, 1941, 14, 63—67).—The sole products of chlorination of aq. BaS at 95 — 100° , using pure Cl_2 or air- Cl_2 mixtures, are BaCl_2 and S. Further chlorination of the reaction mixture leads to production of BaSO_4 , by the reaction $\text{BaCl}_2 + \text{S} + 3\text{Cl}_2 + 4\text{H}_2\text{O} \rightarrow \text{BaSO}_4 + 8\text{HCl}$. Chlorination of aq. $\text{Ba}(\text{SH})_2$ involves the reaction $\text{Ba}(\text{SH})_2 + \text{Cl}_2 \rightarrow \text{BaCl}_2 + \text{H}_2\text{S} + \text{S}$. The solubility of $\text{Ba}(\text{SH})_2$ is $>$ that of BaS, so that the final max. concn. of BaCl_2 attainable from aq. $\text{Ba}(\text{SH})_2$ is $>$ that from BaS. R. T.

Certain properties of barium thiosulphate, in connexion with its use for analytical purposes. G. P. Lutschinski and V. S. Suzdaleva (*J. Gen. Chem. Russ.*, 1940, 10, 2047—2051).—The solubility of BaS_2O_3 rises linearly from 0.194% at 10° to 0.399% at 60° . It falls asymptotically with increasing [EtOH] of the solution, being 2% of the val. in H_2O in the case of 50% EtOH. $\text{Na}_2\text{S}_2\text{O}_3$ forms an insol. 1:1 salt with BaS_2O_3 . R. T.

Reaction between sulphur dioxide and oxides of nitrogen. II. Reaction in sulphuryl chloride solution. C. B. Medinski (*J. Gen. Chem. Russ.*, 1940, 10, 1950—1952; cf. A., 1939, I, 274).— SO_2 does not react with NO_2 — NO in SO_2Cl_2 except in presence of H_2O . R. T.

Preparation of crystalline chromic anhydride from calcium chromate. I. G. Riss, A. E. Zajarni, and A. I. Zelienskaja (*J. Appl. Chem. Russ.*, 1941, 14, 46—62).— CaCl_2 is added in 20% excess to aq. Na_2CrO_4 at 100° , and the ppt. of CaCrO_4 is collected after 1 hr. The solubility of CaSO_4 in aq. CrO_3 rises with increasing $[\text{CrO}_3]$ to a max. at $\sim 30\text{ g. of CrO}_3$ per 100 g. H_2O , thereafter falling rapidly (25° , 60° , and 95°). 95% H_2SO_4 is added to an aq. suspension of CaCrO_4 at 100° , in such amount as to give a $[\text{CrO}_3]$ of 32%, and the solution is filtered. The filtrate is evaporated to a $[\text{CrO}_3]$ of 81%, again filtered, and cooled, when pure CrO_3 separates in good yield. R. T.

Preparation of tervalent manganese. S. V. Gorbatshev and E. E. Schipitski (*J. Gen. Chem. Russ.*, 1940, 10, 1961—1967).—The concn. of Mn^{III} obtainable by anodic oxidation of aq. MnSO_4 at 18° is max. in 11N - H_2SO_4 . The reaction begins abruptly at a voltage of 1.8 (c.d. 24.5—3770 ma. per sq. cm. The yield rises with increasing $[\text{MnSO}_4]$ to 17%. A series of complex equilibrium reactions exists, according to the acidity of the solutions, as follows: $2\text{Mn}(\text{OH})_3 + \text{H}_2\text{SO}_4 \rightarrow \text{Mn}(\text{OH})_4 + \text{MnSO}_4 + 2\text{H}_2\text{O}$ (2N - H_2SO_4); $\rightarrow \text{Mn}_2(\text{SO}_4)_3 + 4\text{H}_2\text{O} \rightarrow \text{Mn}(\text{OH})_4 + \text{MnSO}_4 + 2\text{H}_2\text{SO}_4$; and $\text{Mn}_2(\text{SO}_4)_3 + 3\text{H}_2\text{O} \rightarrow \text{Mn}(\text{OH})_4 + 3\text{H}_2\text{SO}_4$ (2 — 10N - H_2SO_4); $\text{Mn}(\text{OH})_4 + 2\text{H}_2\text{SO}_4 \rightarrow \text{Mn}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$ ($>11\text{N}$ - H_2SO_4); $\text{Mn}_2(\text{SO}_4)_3 \rightarrow \text{Mn}(\text{SO}_4)_2 + \text{MnSO}_4$; $\text{Mn}_2(\text{SO}_4)_3 + \text{H}_2\text{SO}_4 \rightarrow \text{H}_2[\text{Mn}_2(\text{SO}_4)_4]$ (11 — 18N - H_2SO_4). The complex salt $\text{H}_2[\text{Mn}_2(\text{SO}_4)_4] \cdot 8\text{H}_2\text{O}$ crystallises from solution of high acidity (15 — 20N - H_2SO_4) during electrolysis. It is collected, excess of H_2SO_4 is removed by gentle heating, and the salt is stored in air-tight containers. It is a useful oxidising agent. R. T.

Precipitation of carbonates, borates, silicates, and arsenates. P. E. Gagnon, L. Cloutier, and R. Martineau (*Canad. J. Res.*, 1941, 19, B, 179—204).—The influence of concn. and $p\text{H}$ on the composition of several ppts. of carbonates, borates, silicates, and arsenates has been investigated. The following compounds have been isolated: $5\text{CoCO}_3 \cdot \text{Co}(\text{OH})_2$ from $\text{Co}(\text{NO}_3)_2$ and $(\text{NH}_4)_2\text{CO}_3$; $9\text{Pb}_2(\text{AsO}_4)_3 \cdot \text{Pb}(\text{OH})_2$ from $\text{Pb}(\text{NO}_3)_2$ and K_2HAsO_4 ; and $4\text{Pb}_3(\text{AsO}_4)_3 \cdot \text{Pb}(\text{OH})_2$ from $\text{Pb}(\text{NO}_3)_2$ and H_3AsO_4 in presence of NH_3 . Normal CdCO_3 and

PbHAsO₃ were obtained, but attempts to prepare NiCO₃, CoCO₃, BeCrO₄, Zn borates, Cu silicates, and Pb arsenates always resulted in the formation of mixtures of basic salts.

C. R. H.

Oxidation with molecular oxygen. II. Chemistry of the autoxidation of the blue and green basic Co^{II} compounds. W. Feitknecht [with W. Bédert] (*Helv. Chim. Acta*, 1941, 24, 676—693).—When O₂ is bubbled through a suspension of blue Co(OH)₂ (I) at room temp. the oxidation of (I) is accompanied by the transformation of (I) into pink Co(OH)₂ (II). This transformation is so rapid at room temp. that a pure specimen of (I) cannot be obtained, but pure (I) can be prepared at 0°. (I) has a structure in which layers of ordered alternate with layers of disordered material, there being 4 mols. of ordered per mol. of disordered material, and so may be formulated 4Co(OH)₂.Co(OH)₂. The first stage of oxidation proceeds without change of phase, affording a green product having the analogous composition 4Co(OH)₂.CoO(OH) (III). Subsequent oxidation of (III) involves a change of phase, and the product is CoO(OH) (IV), identical with the product of hydrolysis of complex Co^{III} compounds. (III) is unstable, decomp. into (II) and (IV), but can be stabilised by addition of glucose; (I) pptd. in presence of glucose is more slowly oxidised, and the reaction proceeds only as far as (III). (II) is oxidised directly, with change of phase, to (IV). The green basic chloride and bromide have structures like that of (I), i.e., 4Co(OH)₂.Co(OH)X (X = Cl or Br), and their oxidation proceeds analogously, the disordered layers being first oxidised to a bright green intermediate product, 4Co(OH)₂.CoOX. The green basic nitrate, of empirical formula 8Co(OH)₂.Co(NO₃)₂, consists of ordered layers alternating with disordered layers of a basic nitrate, and may be represented 4Co(OH)₂.Co_{1.25}(OH)(NO₃)_{1.6}. The first product of oxidation is 4Co(OH)₂.CoO(NO₃), analogous to (III), but the mechanism of the reaction is more complicated, involving extrusion of Co(NO₃)₂ out of the disordered layers. The oxidation of the blue basic sulphate is apparently analogous to that of the basic halides.

F. J. G.

X.—ANALYSIS.

Chromatographic analysis. A. H. Cook (*Inst. Chem.*, April 23, 1941, 36 pp.).—A lecture.

Spectrochemical analysis of metals.—See B., 1941, I, 460.

Determination of metals in foods.—See B., 1941, III, 265.

Determination of p_H in coloured and turbid solutions. N. A. Tananaev and L. P. Tegentzeva (*J. Appl. Chem. Russ.*, 1941, 14, 127—129).—A colorimetric dialysis procedure is described.

R. T.

Determination of p_H value for alkali soils.—See B., 1941, III, 249.

Conductometric analysis of sodium sulphite and ammoniacal [wood]-pulp liquors.—See B., 1941, II, 340.

Hydride method of determining water in aquo-complex compounds. I. A. G. Elitzur (*J. Gen. Chem. Russ.*, 1940, 10, 1981—1984).—The substance is immersed in abs. EtOH in presence of CaH₂; the vol. of H₂ evolved \propto [H₂O] of the substance. The rate of evolution of H₂ gives an indication of the lability of the H₂O of crystal hydrates.

R. T.

Photo-electric method for the colorimetric determination of hydrogen peroxide with titanium [or vanadium] sulphate. C. B. Allsopp (*Analyst*, 1941, 66, 371).—The yellow colour produced by the action of a Ti salt on H₂O₂ may be measured photo-electrically (e.g., in a Hilger Absorptometer which has been calibrated against standard solutions), although it is not readily detectable visually. The probable errors are 20, 2.5, and 0.25% for concns. of 10⁻⁵, 10⁻⁴, and 10⁻³N, respectively. The reagent is prepared by digesting conc. H₂SO₄ with an excess of TiO₂, diluting to 15—20% concn., and filtering. A solution of V₂O₅ in H₂SO₄ (which changes from green to brown in presence of H₂O₂) is ~25% less sensitive.

J. G.

Determination of total chloride content of heavy oils.—See B., 1941, I, 434.

Colorimetric detection of chlorate ion. M. B. Roy (*J. Indian Chem. Soc.*, 1941, 18, 165—166).—A solution of C₆H₅N in H₂SO₄ develops an intense and permanent violet colour with

chlorates. This may be used as a qual. test or an approx. colorimetric determination.

F. J. G.

Micro-determination of sulphur. Modified bomb method.—See A., 1941, II, 344.

[Colorimetric] determination of sulphides in sewage and sewer atmospheres.—See B., 1941, III, 272.

Determination of sulphate in the presence of chromate. W. B. Meldrum, W. E. Cadbury, jun., and W. W. Lucase (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 456—457).—SO₄²⁻ is pptd. as usual, but in presence of 5 ml. of HCl per 75 ml. of solution to minimise co-pptn., the BaSO₄ + BaCrO₄ is fused with Na₂CO₃, and the co-pptd. CrO₄²⁻ determined iodometrically in the aq. extract. The solution obtained after fusion of asbestos with Na₂CO₃ and extraction of the fused mass with H₂O liberates I from acid KI; hence a Gooch crucible and asbestos cannot be used for filtrations. Filter-paper is satisfactory, since CrO₄ is not reduced when ignited in contact with filter-paper in a muffle furnace. Details of procedure are given. Test data show that for 0.05—0.25 g. of Na₂SO₄, and ratios of Na₂SO₄:Na₂CrO₄ varying from 2.5:1 to 1:1.75, the method is satisfactory.

L. S. T.

Volumetric determination of sulphuric acid in its salts. A. Krüger (*Z. anal. Chem.*, 1940, 119, 216—221; cf. A., 1939, I, 625).—After removal of substances likely to interfere with the purity of the pptd. BaSO₄, and of free HCl and HNO₃ by evaporation, the solution is neutralised (Me-orange), and if poor in salts, 2 g. of NaCl are added. Excess of BaCO₃ [prep. from Ba(OH)₂ and CO₂ given] is added, and the solution is diluted to ~200 c.c. The containing vessel is cooled in ice, and CO₂ is passed into it for 1.5 hr., when the reaction SO₄²⁻ + BaCO₃ + H₂CO₃ \rightarrow BaSO₄ + 2HCO₃⁻ takes place. After filtration, the ppt. is washed with ice-cold, CO₂-saturated H₂O. The resulting solution is evaporated to ~100 c.c. to decompose the small amounts of Ba(HCO₃)₂ formed, filtered, and the HCO₃⁻ equiv. to the SO₄²⁻ titrated with 0.5N-HCl (Me-orange). The method can be shortened by eliminating the washing of the first ppt. by means of decantation, and weighings in the manner detailed.

L. S. T.

Determination of selenium in foods.—See B., 1941, III, 265.

Determination of ammonia and carbamide by modification of the Conway diffusion method. E. Kawerau (*Sci. Proc. Roy. Dublin Soc.*, 1941, 22, 405—413).—NH₃ and CO(NH₂)₂ (4—400 mg. per 100 c.c.) are determined by Abelin's method (A., 1938, III, 785), using a liquid paraffin seal and modified indicator and urease extract.

A. Li.

Microchemistry of the azide ion. G. Denigès (*Bull. Trav. Soc. Pharm. Bordeaux*, 1938, 76, 69—72; *Chem. Zentr.*, 1938, ii, 3956).—N₃⁻ gives cryst. ppts. (illustrated) with TiOAc, Pb(OAc)₂, and ammoniacal HgSO₄ and AgNO₃ solutions.

A. J. F. W.

Determination of nitrogen and chlorine in fertilisers.—See B., 1941, III, 250.

Sampling and analysis of phosphorus.—See B., 1941, I, 445.

Colorimetric determination of phosphate in jams, jellies, etc.—See B., 1941, III, 264.

Rapid determination of phosphate in boiler water.—See B., 1941, I, 417.

Use of bromate in volumetric analysis. Determination of arsenic and antimony using internal indicators at ordinary temperatures. G. F. Smith and R. L. May (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 460—461).—Bordeaux, B.C.I. No. 88, Brilliant Ponceaux 5R, B.C.I. No. 185, and naphthol-blue-black, B.C.I. No. 246 (1—2 drops of 0.1 to 0.2% aq. solution), are satisfactory irreversible indicators for the titration of Sb^{III} at acidities varying from 5 to 35 vol.-% of conc. HCl, using KBrO₃ as oxidising agent at room temp., and for oxidation of As^{III} in 20 vol.-% HCl. Fading of the indicator generally occurs before the equivalence point is reached, but an additional drop of indicator introduces no error. The indicator blank is negligible.

L. S. T.

Determination of total boron in soil.—See B., 1941, III, 250.

Determination of silica in products containing fluorine, especially in cryolite. H. Spielhacsek (*Z. anal. Chem.*, 1940, 119, 4—16).—The sample (1 g.) is mixed with 3 g. of anhyd. borax or 6 of Na₂B₄O₇.10H₂O (not B₂O₃) and 14 g. of KHSO₄

are added. The mixture is heated gradually to a high temp. F is volatilised as BF_3 , and, provided that the ratio borax : F is $\leq 6 : 1$, no loss of Si as SiF_4 occurs. When cold, the fused mass is extracted with H_2O and acidified with HCl . The solution is evaporated and dried at $105\text{--}110^\circ$ in a manner designed to overcome the difficulty of dehydrating $\text{SiO}_2 \cdot n\text{H}_2\text{O}$ in presence of much alkali sulphate. Details of procedure and test data with different samples of cryolite are recorded and compared with results obtained by the distillation method for SiO_2 . Advantages over other methods of determination are discussed. L. S. T.

Determination of silicon, phosphorus, and manganese in acid-resisting high-silicon iron.—See B., 1941, I, 456.

Determination of carbon monoxide by combustion over platinum in the presence of excess oxygen. J. R. Branham, M. Shepherd, and S. Schuhmann (*J. Res. Nat. Bur. Stand.*, 1941, 26, 571—589).—The determination of CO by slow combustion has been investigated, both wet and dry gases being used and the contraction after burning, CO_2 produced, and O_2 consumed being measured. Under average laboratory conditions the vol. relations of the reaction are $2\text{CO} + 1\cdot001\text{O}_2 \rightarrow 1\cdot986\text{CO}_2 + 1\cdot014\text{TC}$ (TC = total contraction after burning). The effects of the loss of CO_2 by dissolution and of deviations from the ideal gas laws are evaluated. In the absence of other combustible gases, the best results are obtained from TC + CO_2 produced. J. W. S.

Determination of carbon dioxide. I. F. Richter (*Z. anal. Chem.*, 1940, 119, 109—118).—Apparatus and procedure for liberating and absorbing the CO_2 from carbonates in a closed system are described. The carbonate is decomposed by hot, dil. (1 : 10) H_2SO_4 , and the CO_2 absorbed in aq. $\text{Ba}(\text{OH})_2$, which is finally titrated with 0.1N-HCl (cresolphthalein). Data for several carbonate-containing minerals are compared with those obtained gravimetrically. The method is accurate, and quicker than the gravimetric. L. S. T.

Determination of potassium in fruit products, jams, jellies, etc.—See B., 1941, III, 264.

Effect of temperature of alcohol in determination of potash in fertilisers.—See B., 1941, III, 251.

Determination of sodium and potassium in refractory materials and in various potassium salts.—See B., 1941, I, 451.

Recovery of uranium acetate in the determination of sodium. H. A. Puente and F. R. Marin (*Anal. Assoc. Quim. Argentina*, 1941, 29, 95—99).—U in the residual liquor from Na determinations is pptd. by NH_3 and the resulting $(\text{NH}_4)_2\text{U}_2\text{O}_7$ purified by dissolution in HCl and repptn. until free from Zn, the $(\text{NH}_4)_2\text{U}_2\text{O}_7$ being then converted into U_3O_8 , and thence successively into $\text{UO}_2(\text{NO}_3)_2$, UO_3 , and $\text{UO}_2(\text{OAc})_2$. F. R. G.

Determination of sodium and chlorides in fruit and fruit products.—See B., 1941, III, 264.

Sensitivity of chemical reactions. III. Different types of chemical reactions. Z. Karaoglanov (*Z. anal. Chem.*, 1940, 119, 16—55; cf. A., 1938, I, 637; 1939, I, 212).—Sensitivities, determined under varied conditions and expressed in $\mu\text{g. per } 10 \text{ c.c.}$, are recorded for the following reactions: Li with Na_2CO_3 , Na_2HPO_4 , Na_2HASO_4 , or alizarin-red S (I); NH_4^+ or NH_3 with HgCl_2 , HgCl_2 and Na_2CO_3 , Graves' reagent, NaOCl and KI , aq. I, NaOPh and NaOCl , $\text{Na}_2\text{Co}(\text{NO}_2)_6$, NaH tartrate, picric acid, or CuSO_4 ; Mg^{++} with 8-hydroxyquinoline, or $(\text{CH}_3)_2\text{N}_4$ and KI , and Mg^{++} as $\text{Mg}(\text{OH})_2$ in presence of I, diphenylcarbazide (II), (I), toluyl-orange R, azo-blue, Chicago-blue 6B, Congo-cornith, brilliant-yellow, or alizarin-yellow; Cu^{++} with $\text{C}_5\text{H}_5\text{N}$ and NH_4CNS , $(\text{CH}_3)_2\text{N}_4$ and KI , (II), (I), benzidine in presence of KI , NH_4CNS , KBr or NaCl , or with guaiacum in presence of NH_4CNS , or NaCl , or KBr . The results show that the time factor is of great importance for the sensitivity val. of a pptn. reaction, and that in many reactions sensitivity increases with a decrease in the amount of reagent. Temp. is also important in the reactions with Li⁺. The nature of the reactions between Mg^{++} and the dyes is discussed. L. S. T.

Spectroscopic determination of alkaline-earth metals and of phosphate. T. Török (*Z. anal. Chem.*, 1940, 119, 120—125; cf. A., 1939, I, 277).—The method is based on the non-reducibility and non-volatility of the alkaline-earth phosphates. $\text{n-NH}_4\text{H}_2\text{PO}_4$ is added from a burette to the solution of Ca^{++} ,

Sr^{++} , or Ba^{++} containing Zn and HCl , until the flame reaction, as observed through a spectroscope, disappears. A filter solution of dahlia-violet to eliminate the Na flame, or of dahlia-violet + CuSO_4 to eliminate that of K^+ , can replace the spectroscope. The method is sensitive to 0.4 mg. of Sr and 0.2 mg. of Ca, corresponding with 0.1 c.c. of 0.1N-phosphate solution. With the exception of SO_4^{--} , anions have no effect on the method; Bi^{+++} , Cu^{++} , Sn^{++} , and Ti^+ interfere by deposition of metal on the Zn, and inhibition of H_2 evolution. The method can be applied to the titration of PO_4^{--} with n-SrCl_2 with the appearance of the Sr flame as indicator. L. S. T.

Determination of hardness of water.—See B., 1941, III, 273.

Determination of calcium and sulphur of fertilisers.—See B., 1941, III, 251.

Determination of exchangeable bases in soils.—See B., 1941, III, 249.

Photometric method for the determination of magnesium. W. S. Gillam (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 499—501).—The method described is based on the use of titan-yellow and a photo-electric colorimeter. It affords a rapid means for determining 0.5—300 p.p.m. of Mg in fertilisers and soil extracts. Fading of the coloured complex is prevented by the addition of aq. $\text{NH}_2\text{OH} \cdot \text{HCl}$. 800 p.p.m. of Ca do not interfere with the determination of 1 p.p.m. of Mg, but the Ca^{++} , NH_4^+ , and PO_4^{--} contents should be kept < 500 , 600, and 100 p.p.m., respectively. Al and Sn must be absent. Results agree with those obtained gravimetrically as Mg hydroxyquinolate. L. S. T.

Determination of magnesium and manganese in fertilisers.—See B., 1941, III, 251.

Determination of replaceable magnesium in soils, using 8-hydroxyquinoline.—See B., 1941, III, 250.

Precipitation of zinc sulphide from a solution of ammonium citrate and citric acid. S. A. Coleman and G. B. L. Smith (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 377—380).—The Waring-Fales-Ware method (A., 1919, ii, 246) has been examined critically. The use of $\text{HCO}_2^- \cdot \text{HCO}_2\text{H}$ buffer is unnecessary, since a mixture of NH_4 citrate and citric acid not only keeps Fe in solution but also serves as an efficient buffer solution for the quant. pptn. of ZnS . As in the above method, the precision is 1 in 1000, and some Fe contaminates the ZnS ; this increases with the $[\text{Fe}]$ in the solution. The separation of Zn^{++} from Mn^{++} , Al^{+++} , or Ni^{++} by the NH_4 citrate-citric acid method is satisfactory. Separation from Co^{++} is not complete, but post-pptn. of CoS is minimised by the use of NH_4CNS , which serves also to salt out the ZnS . The use of ZnS , dried at 110° , as a weighing form is untrustworthy. A procedure for the analysis of Zn ores, based on the NH_4 citrate-citric acid method with $(\text{NH}_4)_2\text{SO}_4$ or NH_4CNS as the salting-out reagent, is detailed. L. S. T.

Rapid direct determination of zinc in brass or bronze.—See B., 1941, I, 458.

Determination of zinc in foods.—See B., 1941, III, 265.

Determination of small quantities of lead by means of dithizone. H. Fischer and G. Leopoldi (*Z. anal. Chem.*, 1940, 119, 161—188).—The single-colour process for the colorimetric determination of Pb is discussed, and improved procedure, based on that described previously (A., 1934, 381), described. Treatment of filter-paper, contamination by Pb from glassware, and purification of reagents are discussed. Pb contents of certain reagents are tabulated. Data given for the stability of dithizone in CCl_4 in diffuse daylight show that when solutions are kept under aq. $\text{NH}_2\text{OH} \cdot \text{HCl}$ or 0.1N- H_2SO_4 , H_2SO_4 , but not 0.1N-HCl, in brown glass, they are stable for many weeks. Details of procedure, and test results, together with the best colour ranges for quant. work, are given for the titration of 1—25 $\mu\text{g.}$ of Pb^{++} by the mixed-colour process. The alkalinity of conc. solutions of KCN has no deleterious effect on the completeness of extraction of Pb dithizonate (I); this permits the determination of traces of Pb (10⁻³%) in Cu, Zn, Cd, Ag, Hg, etc. Data showing the determination of 24—40 $\mu\text{g.}$ of Pb in 0.5—4 g. of Zn arc recorded. A 20-fold excess of KCN is necessary to mask Zn and Cd, but a smaller excess suffices for other heavy metals. Traces of Cu^{++} catalyse the oxidising action of many substances on (I), but this effect is overcome completely by adding $\text{NH}_2\text{OH} \cdot \text{HCl}$, and

boiling the solution. The use of a large excess of KCN improves the detection of Pb^{++} against Bi^{+++} and Sn^{++} to 0.5 $\mu g.$ of Pb with 1000 $\mu g.$ of Bi and 2500 $\mu g.$ of Sn^{++} . At pH 9, Pb^{++} (0.5 $\mu g.$) can be detected in presence of a large excess of Tl^+ ($Pb : Tl = 1 : 12,000$). Conditions for the determination of Pb in presence of 1000-fold excess of Bi are laid down. The separation depends on the extraction of most of the Bi at pH 3, and on that of the Pb in the residual Bi by a large excess of KCN. Procedure for the determination of Pb against a 50-fold excess of Tl^+ in presence of a large excess of KCN is also given. The Pb reacts before the Tl^+ .

L. S. T.

Diguanide sulphate as a reagent for the determination of copper. P. Rây and J. Roy-Chowdhury (*J. Indian Chem. Soc.*, 1941, 18, 149–154).—Cu may be determined gravimetrically in presence of Cd, Zn, Mg, and alkalis by pptn. from ammoniacal solution with diguanide sulphate. NO_3^- must be absent. The ppt. is dried at 50–70° after washing with H_2O , EtOH, and Et₂O, and weighed as $[Cu(C_2N_3H_7)_2]SO_4 \cdot 3H_2O$. In absence of a large excess of NH_3 or NH_4^+ salts the determination may be carried out volumetrically with rubeanic acid as indicator. F. J. G.

New precipitant for metals: 5-(8'-hydroxy-5'-quinolinyl)-imino-8-keto-5 : 8-dihydroquinoline ("indo-oxine") with indicator properties. R. Berg and E. Becker (*Z. anal. Chem.*, 1940, 119, 81–90).—In dil. $AcOH-OAc'$ solution, indo-oxine forms blue or bluish-green ppts. with the following ions: Cu^{++} (0.1–0.17), Ag^+ (0.1–2.0), Au^{++} (0.66–2.5), Mg^{++} (1200), Zn^{++} (0.4–1), Cd^{++} (4–8), Hg^{++} (0.6), Ce^{+++} (5), Ga^{+++} (0.4–2), Ti^{+++} (0.2–0.6), Zr^{+++} (1–1.4), Pb^{++} (200), Bi^{+++} (1.6–4), V^{+++} (0.1–0.6), MoO_4^{--} (3), WO_4^{--} (6), Fe^{++} (0.1–0.6), Fe^{+++} (0.4–0.08), Co^{++} (0.1–0.4), Ni^{++} (0.3–0.04), and Pd^{++} (0.4). Sensitivities, $\mu g.$ per c.c., are given in parentheses. In ammoniacal tartrate solution the sensitivities are Cu^{++} , 0.3 and 0.05; Ag^+ , 3.4; Mg^{++} , 0.5; Ca^{++} , 2; Zn^{++} , 5; Cd^{++} , 1.8; Hg^{++} , 12; Co^{++} , 0.7; Ni^{++} , 1–0.5 $\mu g.$ per c.c.; in NaOH-tartrate solution, only Cu^{++} , Cd^{++} , Hg^{++} , Co^{++} , and Ni^{++} give ppts., and the tests are much less sensitive. The reactions can be made more selective, in certain cases, by addition of NaCl, NaCN, or citrate. In dil. solution, the indo-oxine changes colour sharply between pH 6 and 8 (red to blue), and can be used as indicator in the titration of 0.1N-acid and -alkali. In 0.01N-acid solution, or with weak acids and bases, CO_2 must be removed by boiling. Cl^- and CNS^- can be titrated with 0.1N- $AgNO_3$ with indo-oxine as indicator in presence of $AcOH$; an org. solvent, MeOH, EtOH, or $COMe_2$ (50 vol.-%), must be present. Br^- and I^- can be titrated in neutral and dil. $AcOH$ solutions with 0.01N- $AgNO_3$, but for Br^- , titration with 0.1 or 0.01N- $AgNO_3$ is not recommended. Small amounts (0.2–1 mg.) of Cu^{++} or Ni^{++} or Hg^{++} (0.5–2.5 mg.), can be titrated directly with an EtOH solution of indo-oxine in presence of $AcOH-OAc'$ using the filtration method to find the end-point. Addition of NaCl enables Cu^{++} to be determined in presence of Hg. Details of procedures and test data are recorded. L. S. T.

Use of nitroso-derivatives as reagents in inorganic analysis. II. S. S. Guha-Sircar and S. C. Bhattacharjee (*J. Indian Chem. Soc.*, 1941, 18, 161–163).— Cu 1-nitroso- β - and 2-nitroso- α -naphthylamine, $(C_{10}H_7ON_2)_2Cu$, are described. They are suitable for the gravimetric determination of Cu in presence of Cd. Both nitrosonaphthylamines also give ppts. with Ni^{++} , but these are not suitable for gravimetric determination. F. J. G.

Determination of copper and zinc in fertilisers.—See B., 1941, III, 251.

Analysis of beryllium-coppers.—See B., 1941, I, 458.

Determination of copper and nickel in aluminium alloys.—See B., 1941, I, 461.

Assaying mercury ores.—See B., 1941, I, 459.

Determination of cerium, and separation of thorium and cerium by means of 8-hydroxyquinoline. R. Berg and E. Becker (*Z. anal. Chem.*, 1940, 119, 1–4).—In ammoniacal solution containing tartrate, Ce^{+++} gives with 8-hydroxyquinoline a yellow ppt. (sensitivity 0.59 $\mu g.$) which dries in air to a greenish-grey product, $Ce(C_8H_6ON)_3$. The ppt. can be dried at 110° and weighed, or ignited with $H_2C_2O_4$, or determined volumetrically with BrO_3^- - Br^- after dissolution in 3N-HCl. The solution of Ce (10–50 mg. of Ce per final vol. of 100 c.c.) is first reduced by means of $NH_2OH \cdot HCl$. Separation

from Th is effected by pptg. the Th as $Th(C_8H_6ON)_4 \cdot C_8H_6ON$ in $AcOH$ solution, and then the Ce as indicated above. Details of procedures and test data are recorded.

L. S. T.

Spectrophotometric determination of praseodymium, neodymium, and samarium. C. J. Rodden (*J. Res. Nat. Bur. Stand.*, 1941, 26, 557–570).—In a solution containing rare earth and associated metals as nitrates, Pr, Nd, and Sm can be determined by measuring the transmittancy of the solution with a double monochromator photo-electric spectrophotometer. The most suitable absorption bands for examination are Pr 4460 Å., Nd 5210 and 7980 Å., and Sm 4020 Å. $Nd(NO_3)_3$ solutions of concn. ≥ 10 g. per l. obey Beer's law, but $Pr(NO_3)_3$ and $Sm(NO_3)_3$ solutions do not obey this law. The method of correcting for the interference of each element is discussed. A procedure for the analysis of the Ce group of metals is suggested.

J. W. S.

Chemical analysis of alloy cast iron.—See B., 1941, I, 456.

Determination of iron in beer.—See B., 1941, III, 258.

Oxidation of graphite in analysis of ferrous metals.—See B., 1941, I, 457.

Use of nitroso-derivatives as reagents in inorganic analysis. I. S. S. Guha-Sircar and S. C. Bhattacharjee (*J. Indian Chem. Soc.*, 1941, 18, 155–160).—The following sparingly sol. inner complex Co salts with aromatic NO-compounds are described: Co^{III} 1-nitroso- β -naphthylamine (I) and Co^{III} 2-nitroso- α -naphthylamine, $(C_{10}H_7ON_2)_2Co$ (II); Co^{III} oximinodimedone, $(C_8H_9O_2N_2)_2Co$ (III); Co^{III} diinitrosoresorcinol, $(C_6H_3O_4N_2)_2Co$; Co^{III} diinitroso-*orcinol*, $(C_7H_5O_4N_2)_2Co$. (I), (II), and especially (III) are suitable for gravimetric determination of Co. F. J. G.

Critical study of qualitative reagents for cobalt cations. P. Wengcr and R. Duckert [with M. Busset] (*Helv. Chim. Acta*, 1941, 24, 657–670).—A large no. of reagents which have been suggested for the detection of Co^{++} have been tested, and the results, with data on sensitivity and specificity, are tabulated; these include 31 which are recommended for use under specified conditions. F. J. G.

Fractional detection of cobalt and lead. N. A. Tananaev and L. P. Tegentzova (*J. Appl. Chem. Russ.*, 1941, 14, 130–132).—Excess of $Zn(OH)_2$ is added to the neutral solution, to ppt. Cr, Fe, Al, Bi, Cu, and Hg, and the solution is filtered. $Zn(OH)_2$ and $KMnO_4$ are added to the filtrate, which is then boiled and filtered, and the ppt. is washed with aq. NH_4NO_3 and dissolved in dil. HNO_3 . Pb is detected in one portion of the solution as $PbSO_4$ or PbS , and Co in a second portion by adding NH_4CNS and $COMe_2$. R. T.

Detection of certain metals in minerals and ores. Ammonium hypophosphite fusion method. H. B. Van Valkenburg and T. C. Crawford (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 459–460).—0.1 g. of mineral or ore is heated with 2 g. of $NH_4H_2PO_3$ (not Na or K salt), and the colour of the fused mass alone or after treatment with H_2O or H_2O_2 is the basis of detection. Co, Ti, and W give blue melts, but the Co melt turns pink on cooling. With W, the blue colour changes to violet when the warm melt is moistened with H_2O , and with Ti the change is to faint rose colour, which is turned orange-red by addition of H_2O_2 . V, Cr, and U give green melts; that due to V is red when hot. Mo minerals, except molybdenite, give a reddish-brown melt. Mn minerals yield a clear melt, which gives the permanganate colour when excess of HNO_3 is added and then removed by boiling. Te minerals are reduced to metal, which eventually gives a wine-red colour; H_2O changes this colour to black. Nb and Ta give no colour, but black particles can be seen throughout the melt. Any one of the above metals can be detected by these tests in their minerals, but not necessarily in presence of any or all of the others. Mn can be detected in presence of Ag, Pb, Hg, Bi, Cu, Cd, As, Sb, Sn, Co, Ni, Cr, Al, and Zn.

L. S. T.

Analysis of platinum-iridium ores.—See B., 1941, I, 460.

XI.—APPARATUS ETC.

Differential calorimeter. N. Fontell (*Soc. Sci. fenn., Comm. phys.-math.*, 1938, 10, No. 5, 18 pp.; *Chem. Zentr.*, 1938, ii, 3839).—A differential calorimeter of simple design is described; quantities of heat of –35 to –350 g.-cal. can be

determined with an accuracy of 0.1% (H_2O -val. 1000 g.; temp. differences measured to $\pm 0.00015^\circ$). Data for the heat of dissolution of KCl are in good agreement with the results of Lange and Monheim (A., 1930, 1152).

A. J. E. W.

Copper blocks and optical system for determining b.p. (Emich method) and m.p. A. A. Morton and J. F. Mahoney (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 498—499).—Details of construction are illustrated.

L. S. T.

Circuit for temperature controls. B. Noyes (*Science*, 1941, 93, 286—288).—Apparatus utilising the Ward Leonard 106 type relay and a Hg thermometer with Pt contacts is described and illustrated.

L. S. T.

Use of the term "resolving power" in spectroscopy. S. Tolansky (*Nature*, 1941, 148, 54).—Examples showing that the classical resolving power as an index of an instrument should be replaced are discussed. A more useful and practical measure of the effective applicability of an instrument is the "resolving limit," now defined as $dv = v.d\lambda/\lambda$, i.e., the instrumental line width in cm^{-1} at a given λ .

L. S. T.

Photo-electric colorimetric technique for the dithizone system. F. L. Kozelka and E. F. Kluchesky (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 484—487).—A technique adapted to photo-electric colorimeters for the determination of one component in a two-component system is described. It is especially suitable for the dithizone (I) system; it eliminates the necessity of removing excess of (I), and of the use of standard solutions of (I). $\pm 1 \mu g.$ of Pb can be recovered.

L. S. T.

Modified eyepiece micrometer for use in dust counting. W. B. Harris (*J. Ind. Hyg.*, 1941, 23, 148—150).—The micrometer is made by fixing strands of glass wool on the diaphragm of the eyepiece to form a grid of 25 squares; it is calibrated against a stage micrometer.

E. M. K.

Direct-reading microphotometer. G. O. Langstroth, K. B. Newbould, and W. W. Brown (*Canad. J. Res.*, 1941, 19, A, 103—108).—In the direct-reading photo-electric microphotometer described the photographic plate, the observation screen containing the slit admitting light to the photo-cell, and the galvanometer scale are grouped together in a vertical row so as to minimise the fatigue of observation. The operation of the instrument, which is designed for use in spectrographic analysis, is described in detail.

J. W. S.

Recording photometer with photo-cell. G. Weber (*Licht*, 1938, 8, 145—147; *Chem. Zentr.*, 1938, ii, 3839).—The construction and use of a photometer employing barrier-layer cells are described. As the cells are colour-corr. the instrument may be used for sources giving light of different colours in different directions.

A. J. E. W.

Subjective " V_λ -true" photometry. M. Richter (*Licht*, 1938, 8, 127—128; *Chem. Zentr.*, 1938, ii, 3839).—The spectral brightness curve for an individual observer can be corr. to any standard curve by supplying the observer with suitable ocular filters, the design of which is discussed.

A. J. E. W.

Use of step weakness in photographic photometry. G. E. Moore and H. W. Webb (*J. Opt. Soc. Amer.*, 1940, 30, 413—414).—The calibration of a step weakener of five steps formed by a Pt sputtered 5° quartz wedge is described. Comparison of intensities of spectral lines in two spectra was made with an accuracy of from 1 to 5% by use of the wedge. No measurable change in the sputtered films had occurred after $2\frac{1}{2}$ years. A Hg arc giving const. intensity distribution and total intensity was obtained by cooling with air jets controlled by a relay in the arm of a Wheatstone bridge and maintaining the voltage across the lamp to ± 0.2 v.

O. D. S.

Spectrophotometer for measurement of optical filters. S. W. Seeley and E. I. Anderson (*Rev. Sci. Instr.*, 1941, 12, 392—395).—A disc revolving at 1800 r.p.m. has two apertures in its circumference at 180° to each other. The optical filter is mounted in one aperture. Light passes through both on to a photo-cell and oscilloscope. The ratio of the amplitude of the two superimposed curves gives the transmission of the filter. Simultaneous measurements of several filters may be made by increasing the no. of apertures in the disc.

D. F. R.

Photo-electric photometer for colorimetric determinations in water and sewage.—See B., 1941, III, 274.

New technique for making thin [X-ray] targets. L. T. Pockman and D. L. Webster (*Rev. Sci. Instr.*, 1941, 12, 389—392).—A 10-sq. cm. cellulose acetate film, 5×10^{-6} cm. thick, is deposited from solution on to a glass plate and then floated off by H_2O across a circular opening in a brass holder. From there it is stretched over the flat ends of 6 U-shaped wires, 0.003 in. diameter, mounted in the target holder. A Ni film, 10^{-6} cm. thick, is then deposited on the cellulose acetate by evaporation.

D. F. R.

Use of infra-red film for electrophoretic and ultracentrifugal analyses. H. P. Treffers and D. H. Moore (*Science*, 1941, 93, 240).—Infra-red films or plates can often be used for systems opaque to visible light. Protein solutions containing dyes or bacterial pigments, or solutions of I in CCl_4 , can be thus examined.

L. S. T.

Adjustable infra-red absorption cell for liquids. E. S. Barr (*Rev. Sci. Instr.*, 1941, 12, 396—397).—The device, which replaces the use of foil or mica washers, regulates cell thickness by means of a micrometer screw and wedge arrangement. Films of non-volatile liquids are readily prepared to within 1μ , up to 200μ , without estimation.

D. F. R.

Preparation of high-melting alloys with the aid of electron bombardment. R. Hultgren and M. H. Pakkala (*J. Appl. Phys.*, 1940, 11, 643—646).—In the electron bombardment vac. furnace described, a refractory crucible is surrounded by a positively charged Ta cup bombarded with electrons emitted by a W filament. The m.p. of Ta (2850°) was attained with the expenditure of 700 w. Pt, Ir, Fe, Co, V, Ti, and Zr were melted without difficulty in Al_2O_3 and ZrO_2 crucibles.

L. J. J.

Construction of glass bellows. D. J. Pompeo and E. Meyer (*Rev. Sci. Instr.*, 1941, 12, 368—369).—Glass bellows (alternative to helical tubes for preventing breakage due to differential expansion) can be made in tubes ≥ 5 in. in diameter if the tube is held accurately centred in a glass lathe and rotated while the convolutions are being formed with a hand blow-pipe and C rod. Thorough annealing is necessary.

A. A. E.

Preparation of quartz ultrasonic oscillators. R. R. Bajpai and V. I. Vaidhianathan (*Proc. Indian Acad. Sci.*, 1941, 13, A, 504—509).—Details of selection of natural quartz crystals free from twinning and heterogeneity, and of the cutting and grinding of thick X-cut sections, are given.

L. J. J.

Refrigerating condenser. Application in vacuum distillation assembly. G. Hunter (*Canad. Chem.*, 1941, 25, 447—450).—The condenser described consists of a box of monel metal fitted with a commercial refrigerating unit and attached to a vac. line. Details of assembly and operation, and performance in recovering large vols. of H_2O or org. solvents, are given. Large vols. of extracts can also be reduced to a small vol. with little change in heat-labile or easily-oxidised materials.

L. S. T.

Immersed capillarimeter. A new form of device for measuring surface tension of liquids in closed space. M. P. Poljakov (*J. Phys. Chem. Russ.*, 1940, 14, 137—138).—An inverted U-tube composed of two different capillaries is immersed in liquid and the difference between the capillary rises measured.

J. J. B.

Evaporation technique for beryllium, rhodium, and silicon. Y. Moriya (*Electrotech. J.*, 1938, 2, 219; *Chem. Zentr.*, 1938, ii, 3955).—The vessel described, which is constructed from W wire and sintered ThO_2 , permits evaporation of highly infusible materials in a vac., but is itself almost non-volatile.

A. J. E. W.

Labelling bottles. C. Gurchot and J. K. Finnegan (*Science*, 1941, 93, 288).—Paper labels can be protected with cellulose transparent tape.

L. S. T.

Mechanical polishing [of minerals] with a film of abrasive. J. O. Fuller (*Econ. Geol.*, 1941, 36, 199—211).—An improved method, utilising a film of abrasive on metal laps, is described. A mounted surface can be ground and polished in < 1 hr., and the resulting surface is free from scratches and relief. Details of procedure are given.

L. S. T.

Condenser for use during digestion operations. R. Szymanowicz (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 455).—A

round-bottomed Pyrex flask, fitted with inlet and outlet tubes for H_2O , fits in the mouth of a beaker. L. S. T.

Pendulum method for measuring settling velocities. J. H. McMillen, L. F. Stutzman, and J. E. Hedrick (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 475—478).—Procedure and apparatus for determining the stability of a suspension and the rate of particle fall, utilising a compound pendulum, are described. The method is particularly suitable for opaque liquids, and it has been applied to suspensions of coal particles in oil fuel, and the settling of paint pigments and of milk in cream. The theory of the method is described, and approx. expressions for calculating velocities of fall are given. L. S. T.

Gas distributors using alundum discs. S. E. Jolly (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 478).—The sealing of alundum discs into Pyrex tubing is described. L. S. T.

Automatic continuous percolator. M. S. Schechter and H. L. Haller (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 481—482).—Improvements in the apparatus described previously (A., 1938, I, 478) are detailed and illustrated. Large quantities of ground plant material can be extracted with little loss of solvent. L. S. T.

Power compactor for air-permeation experiments. E. L. Gooden (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 483—484).—The construction and use of a device for compacting powders are described. A column of any desired height is built up in the sample tube by simultaneous compacting and deposition of the sample. The device is suitable for use with the self-calculating air-permeation apparatus for measuring surface mean diameter of powders. Comparative results obtained by this and vibration methods are given for powders of talc, diatomaceous earth, As_2O_3 , and synthetic cryolite. L. S. T.

60-Plate low-hold-up laboratory fractionating column. A. J. Bailey (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 487—491).—The all-glass column described and illustrated is filled with glass helices. It has an efficiency of ~60 theoretical plates, and a hold-up of <0.1 ml. per plate. It can be used for the laboratory separation of complex mixtures. A flexible still head permits operation under total reflux, or variable or total take-off, and at atm. or reduced pressure. L. S. T.

Analysis of a single drop of liquid by micro-fractionation. A. A. Morton and J. F. Mahoney (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 494—498).—A procedure and apparatus for collecting 30—70 fractions from a single drop of liquid are described. The fractionation is performed with one of two types of capillary, packed with glass wool, heated in a Cu block. The b.p.-fraction no. curve shows the existence of more than one component and the % composition. Curves for numerous mixtures of org. liquids illustrate the results obtainable. L. S. T.

Nomograms for correction of barometer readings for temperature and gravity. G. Barr and H. A. Sloman (*J.S.C.I.*, 1941, 60, 203—205).—Since an accuracy of ± 0.1 mm. in the reading of the barometric height is ample in most routine chemical analyses, there is a temptation to ignore the correction for temp., which may, however, vary by 1 mm. or more on different days. The sum of the corrections for temp. and (at a fixed station) for gravity may be read off very simply from a nomogram, and it is desirable to mount a chart alongside the barometer so that readings may be corr. at once. The principle of construction of a nomogram for use with the Fortin-type barometer is detailed, and a reproduction is given of one for use with a Kew-type barometer.

Comparative tests of chemical glassware.—See B., 1941, I, 450.

XIII.—GEOCHEMISTRY.

Theory of ground-water motion. M. K. Hubbert (*J. Geol.*, 1940, 48, 785—944). L. S. T.

Geochemical studies of the volcanoes of Japan. XXIV. Radon content of mineral waters in Masutomi. S. Oana and K. Kuroda (*Bull. Chem. Soc. Japan*, 1940, 15, 485—486).—Data on Rn content, temp., and p_H of a no. of mineral springs are given. F. J. G.

Analysis of some mineral waters from Ancash. L. A. Saldaña (*Bol. Soc. Quím. Peru*, 1941, 7, 76—84).—Ionic concn.,

hardness, and total solids are recorded for seven samples of mineral H_2O collected in the province of Ancash (Peru).

F. R. G.

Temperatures and salinities under the ice in a shallow inlet. A. W. H. Needler (*J. Fish. Res. Bd. Canada*, 1941, 5, 236—243).—In Bideford "River," an arm of Malpeque Bay, a layer of H_2O , 6 in.—3 ft. in thickness, of low salinity, is formed under the ice and persists until the disappearance of the ice. The min. possible temp. of this layer is $>$ the f.p. of the bottom H_2O and convective mixing of the surface and bottom H_2O is largely prevented. The temp. of the bottom H_2O is lowest early in winter when open H_2O is relatively near, then the temp. gradually rises as winter progresses until it approx. that of the surface H_2O .

R. G. W.

Metamorphism of sediments of the deep well near Wasco, California, and of the deeply-buried Eocene sediments near Ventura, California. J. B. Lyons (*J. Geol.*, 1940, 48, 436—443).—The sandstones and shales of this well, which were buried to a depth of 15,000 ft. and heated to 146° , have undergone no metamorphism other than the recrystallisation of the clay material to kaolinite. The similar sedimentary beds from the Ventura Basin, which were buried to a greater depth, have only minor amounts of sericite, chlorite, and epidote as metamorphic products. These facts indicate the inefficiency of load metamorphism in some Cenozoic strata.

L. S. T.

Problems in the study of meteorites. W. F. Foshag (*Amer. Min.*, 1941, 26, 137—144).—A review of present knowledge, and a discussion of such problems as structure and origin.

L. S. T.

Nature of the ore-forming fluid. W. J. Bichan (*Econ. Geol.*, 1941, 36, 212—217; cf. A., 1940, I, 379; 1941, I, 61).—Shortcomings of hydrothermal solutions as important ore-carriers or as agents of ore-deposition are pointed out and discussed.

L. S. T.

Petrified wood composed of iron oxide. L. B. Roberts (*J. Geol.*, 1940, 48, 212—213).—Petrified wood composed essentially of Fe_2O_3 occurs in the Wilcox Eocene sand at Shreveport, Louisiana.

L. S. T.

Origin of the Surigao [Mindanao] iron ores. D. F. Frascché (*Econ. Geol.*, 1941, 36, 280—305).—This Fe ore deposit occurs as a superficial mantle over serpentinised ultrabasic rocks. The ores are residual in origin, having been formed *in situ* by the subaerial decomp. of the serpentine rock. Chemical analyses [H. C. Witt] of samples taken at uniform intervals from a vertical section of serpentine rock and Fe ore are recorded; they show the changes that have taken place during the formation of the ore from the rock. Petrographic examination of the country rock reveals destruction of olivine, pyroxene, and serpentine minerals with accompanying formation of Fe oxides. Graphs of progressive chemical changes that have occurred during the formation of the ore indicate rapid losses of the more sol. constituents such as SiO_2 and MgO , and gains of Al_2O_3 , Fe, Cr, Ni, and Co. Chemical analyses of 2000 samples show that the ore is fairly uniform in grade. The average analysis is Fe 47.77, Al_2O_3 7.93, Cr_2O_3 4.19, Ni-Co 0.78, SiO_2 1.33, P 0.03, S 0.17, H_2O 40.38%. The Surigao and Cuban laterites are similar in physical character, mineralogy, and chemical composition.

L. S. T.

Ore minerals of the La Plata mountains, Colorado, compared with other telluride districts. F. W. Galbraith (*Econ. Geol.*, 1941, 36, 324—334).—The main stages in the history of the ore formation are (i) deposition of quartz and pyrite (I), (ii) carbonates and other minor gangue minerals, (iii) vein sulphides in the order (I), sphalerite and chalcopyrite, tetrahedrite, and galena, (iv) tellurides, contemporaneous in age, and (v) native Au. Hessite is the most abundant of the tellurides, coloradoite the most widespread, krennerite is much less abundant and widespread, whilst calaverite, sylvanite, petzite, and native Te are present only sparingly. Supergene alteration of the ores is relatively unimportant, but the occurrence of native Te as a supergene replacement product of telluride minerals in ores from both Cripple Creek and Porcupine is probably the first of the kind to be described.

L. S. T.

Pre-Cambrian crystalline rocks of north-central Utah. A. J. Eardley and R. A. Hatch (*J. Geol.*, 1940, 48, 58—72).—Sedimentary rocks, siliceous igneous rocks, injection gneisses, and

mafic rocks, all metamorphic, are described, and mineral analyses given. L. S. T.

Dilation and replacement dykes. G. E. Goodspeed (*J. Geol.*, 1940, 48, 175—195).—Investigation of dykes in the Pacific Northwest, ranging from basalt and diabase to aplite and pegmatite, gives evidence of two contrasting mechanisms of dyke formation, viz., dilation concomitant with magmatic injection, and replacement. L. S. T.

Tentative classification of sand dunes; its application to dune history in the Southern High plains. F. A. Melton (*J. Geol.*, 1940, 48, 113—145). L. S. T.

Progressive metamorphism of siliceous limestone and dolomite. N. L. Bowen (*J. Geol.*, 1940, 48, 225—274).—The metamorphism of siliceous dolomitic limestone is discussed with the aid of a composition tetrahedron which suggests that the changes can be referred to 13 grades or steps of increasing decarbonation, taking place at successively higher temp. at any given pressure. At the temp. appropriate to each step a certain phase assemblage becomes unstable, and each step is characterised by the disappearance of this assemblage. In 10 of the steps this disappearance is accompanied by the more conspicuous appearance of a new phase, a metamorphic mineral. In order of the increasing temp. steps at which they are produced the 10 minerals are tremolite, forsterite, diopside, periclase, wollastonite, monticellite, akermanite, spurrite, merwinite, and larnite. Examination of their natural occurrence suggests that these minerals are produced mainly under conditions that permit their use as temp. indicators. L. S. T.

Contact and endomorphic phenomena associated with a part of the Idaho batholith. A. L. Anderson and V. Hammerand (*J. Geol.*, 1940, 48, 561—589).—Hydrothermal changes are described. L. S. T.

Artificial helictites and gypsum flowers. L. C. Huff (*J. Geol.*, 1940, 48, 641—659).—Deposits similar to natural helictites have been formed in the laboratory by allowing aq. $\text{Na}_2\text{S}_2\text{O}_3$, $\text{K}_2\text{Cr}_2\text{O}_7$, CaCl_2 , and CuSO_4 to evaporate. These deposits indicate that natural helictites grow at the free and not at the attached end, and assume their shape as a result of the chance orientation of crystals. Artificial formations similar to gypsum flowers indicate that porous rock is necessary for the growth of the natural flowers, which grow at the attached end, and assume their curvature, not as a result of strain, but of differential rate of growth. L. S. T.

Rigidity of rocks at high pressure. F. Birch and D. Bancroft (*J. Geol.*, 1940, 48, 752—766).—Previous work (A., 1938, I, 480) is extended to pressures of 9000 kg. per sq. cm. and temp. up to 150° for certain igneous rocks. Changes of velocity on heating to 150° at 4000 kg. per sq. cm. for sedimentary and metamorphic rocks have also been determined. The dependence of velocity on composition is discussed. L. S. T.

Diorite-kinzigite formation in the surface deposits of the Dent Blanche (Valpellina range), in the Aosta region. E. Sanero (*Period. Min.*, 1938, 9, 35—52; *Chem. Zentr.*, 1938, ii, 3904).—A geological and petrographic study of quartz-diorite, micaceous schist, contact rocks, and pegmatites from the deposit is reported. A. J. E. W.

Luminescent minerals; (A) fluorite; (B) fluorescence in the sodalite group and related groups; (C) natural zinc compounds. M. Deribère (*Ann. Soc. géol. Belg. [Bull.]*, 1937, 60, 377—381; 1938, 61, 52—55, 104—108; *Chem. Zentr.*, 1938, i, 268, 2501; ii, 3894).—(A) Specimens from different sources have been examined; their photo- and thermo-luminescence show no inter-relation. The photoluminescence is violet unless the colour is influenced by rarer elements or hydrocarbons; the latter produce yellow fluorescence in a brown fluorite from Ontario.

(B) Previous observations are in general confirmed. An Ontario hackmannite contains two distinct constituents showing pink and blue fluorescence, which have d 3.4, 3.3, and hardness 5.5, 5, respectively.

(C) Wide variations with the source, composition, and mode of formation are observed. Oxides, carbonates, and hydroxides give little characteristic fluorescence. Some Zn blends show fluorescence or triboluminescence. Some willemite specimens do not fluoresce, but others (particularly specimens containing Mn) show a strong green fluorescence in ultra-violet light. A. J. E. W.

Morenosite from Valtournanche. A. Cavinato (*Period. Min.*, 1938, 9, 141—142; *Chem. Zentr.*, 1938, ii, 3903).—A very pure specimen has the composition $\text{NiSO}_4 \cdot 6.5\text{H}_2\text{O}$ (NiO 27.16, SO_3 29.58, H_2O 42.49%). A. J. E. W.

Natural basic carbonates of copper and zinc. C. Lauro (*Period. Min.*, 1938, 9, 105—136; *Chem. Zentr.*, 1938, ii, 3903).—A chemical and X-ray examination of paraurichalcites (including a specimen associated with malachite at Tsumeb) and other basic Cu Zn carbonates shows the existence of two groups, $2\text{R}^{\text{II}}\text{CO}_3 \cdot 3\text{R}^{\text{II}}(\text{OH})_2$ and $\text{R}^{\text{II}}\text{CO}_3 \cdot \text{R}^{\text{II}}(\text{OH})_2$, in which $\text{CuO}:\text{ZnO}$ is $<$ or $>$ 1, respectively. The first group includes aurichalcite and the second, which shows similarities to malachite, includes rosasite, paraurichalcite-I and -II, and cuprozincite. A. J. E. W.

Barytes from Campo Pisanu (Iglesias). C. Lauro (*Period. Min.*, 1938, 9, 139—141; *Chem. Zentr.*, 1938, ii, 3903).—The mineral consists of aggregates of small crystals which are tabular on {001} and somewhat prolonged along [010]; the angles correspond with $a:b:c = 0.8152:1:1.3136$. A. J. E. W.

Quicksilver deposits of the Terlingua Region, Texas. C. P. Ross (*Econ. Geol.*, 1941, 36, 115—142).—A detailed account of work already noted (A., 1940, I, 422). The gangue minerals, especially the calcite, were derived probably from the sedimentary rocks with some addition of material from deep sources. L. S. T.

Quartz xenocrysts in olivine basalt from the southern Sierra Nevada of California. R. W. Webb (*Amer. Min.*, 1941, 26, 321—337).—Isolated bodies of little-known volcanic rocks are described. Olivine basalts containing well-defined quartz xenocrysts are common. The quartz may be derived from the alteration of numerous inclusions of granodiorite in the volcanic rocks. L. S. T.

Thermoluminescence of quartz after irradiation with X-rays. T. Futagami (*Proc. phys.-math. Soc. Japan*, 1938, [iii], 20, 458—466; *Chem. Zentr.*, 1938, ii, 3894).—Quartz becomes opaque on exposure to X-rays and afterwards emits a blue luminescence on warming. The absorption spectrum of the irradiated quartz extends from the infra-red into the ultra-violet, with flat max. at 302 and 390 $\text{m}\mu$. The thermoluminescence spectrum (385—610 $\text{m}\mu$) has a max. at 469 $\text{m}\mu$; the intensity distribution and its variation with time and temp. are examined. A. J. E. W.

Gray quartz breccia ore body of the Highland Mine, Butte, Montana. R. C. Newcomb (*Econ. Geol.*, 1941, 36, 185—198).—The auriferous-quartz ore body of this mine is an open-textured siliceous sponge-breccia, which occurs as a replacement of Cambrian dolomite. The sponge texture is secondary; it has arisen from the abstraction of sulphides, mainly pyrite. Volumetric accommodation to the leaching was marked by the collapse of many primary ore structures, and by considerable slumping. The fragments are now cemented weakly by SiO_2 . The leaching, by residual concn., improved the grade of the ore. L. S. T.

Mineral resources of Mayurbhanj State. D. C. Nag (*Quart. J. Geol. Soc., India*, 1940, 12, 61—71).—The following are described briefly: hematite, extensive V-bearing magnetite, and Cu belts, deposits of Au, Ti, Mn, refractory and building materials. The genesis of the ore deposits is discussed. L. S. T.

Unusual occurrence of carbon in cavities of limestone. N. L. Sharma and K. B. Swamy (*Quart. J. Geol. Soc., India*, 1940, 12, 73—76).—The limestone of Baraduar area, Bilaspur district, C.P., contains cavities lined with calcite, the inter-spaces of which are filled with soft, jet-black lumps of finely-divided, impalpable C. Meteoric waters were probably responsible for the deposition of the C and the limestone. The C is of org. origin. L. S. T.

Fuller's earth deposits of Jodhpur State, Rajputana. K. L. Bhola (*Quart. J. Geol. Soc., India*, 1940, 12, 83—97).—Deposits at Kapurdi, Rohli, Joranada, and Dip-ki-Dhani are described. The occurrence, properties, mining, and uses of the earth are described. Fuller's earth from Kapurdi contains SiO_2 47.00, Al_2O_3 23.30, Fe_2O_3 6.95, CaO 2.90, MgO trace, $\text{K}_2\text{O} + \text{Na}_2\text{O}$ 5.92, loss on ignition 13.55, total 99.62%. L. S. T.

Analysis of Washington coals.—See B., 1941, I, 429.

BRITISH CHEMICAL AND PHYSIOLOGICAL ABSTRACTS

A., I.—General, Physical, and Inorganic Chemistry

DECEMBER, 1941.

I.—SUB-ATOMICS.

Fuse spectrum of aluminium. S. Venkatesha (*Current Sci.*, 1941, 10, 287—288).—The spectrum of the explosion of an Al wire produced by a current of 60 A. from a 120-v. d.c. supply shows a continuous background to <2100 Å., absent in the low-current arc spectrum. The atm. of Al vapour produced gives rise to the absorption of the sharp series lines $3^2P_{1,2} \rightarrow n^2S_1$ which are reversed against the continuum up to $n = 14$.

Spectra of argon in the extreme ultra-violet. L. W. Phillips and W. L. Parker (*Physical Rev.*, 1941, [ii], 60, 301—307; cf. A., 1940, I, 335).—In a simple method described for the excitation of spectra of higher stages of ionisation in rare gases the gas is introduced directly into the space between the two electrodes of an ordinary vac. spark. Spectra of all ionisation stages from A III to A IX were obtained. Classified lines for A v to A IX and term vals. are tabulated, and minor additions and corrections to data for Cl v and Cl vi are given.

N. M. B.

Afterglow in mercury vapour. I. Intensity-pressure relations. II. Spectral intensity distribution. R. C. Garth and G. E. Moore (*Physical Rev.*, 1941, [ii], 60, 208—215, 216—224).—I. The intensities of the stronger lines in the subordinate series of the afterglow spectrum were measured photographically as a function of v.p. 0.1—2.0 mm. Hg in a stream of vapour distilled from a Hg arc into a side tube. With ion concn. const. at the point of observation, increased pressure greatly increased the intensity of a given line and also caused a marked change in the intensity distribution in a given series. At const. pressure the intensities varied approx. linearly with ion concn. Introduction of fast electrons into the stream, or removal of positive ions, quenched the afterglow line spectrum. Results indicate that the line spectrum is produced by a complex recombination process in which collisions with neutral atoms are important, probably resulting in the formation of mol. particles which later break up to produce excited atoms responsible for the spectrum. Diffuse bands, attributable to mols. each composed of a neutral atom and an atom in one of the $6^3P_{0,1,2}$ states, were observed under certain conditions.

II. The relative intensities of 200 intense lines of the afterglow spectrum were measured photographically. From measuring the abs. intensity of the group 3650—3663 Å. radiated by 1 c.c. of vapour, the abs. intensities were determined and the total no. of quanta radiated per sec. from unit vol. calc. These results and the measured rate of change of positive ion concn. near the point of observation showed that the total no. of quanta radiated per sec. was much too great to be accounted for by assuming the afterglow to be produced by simple recombination of ions and electrons. A comparison of the no. of quanta entering each at. state by radiative transitions with the no. similarly leaving this at. state showed that the average energy of the excited atoms emitting the line spectrum was ~ 9 e.v. Results are best explained by assuming that mol. particles of mean life $\sim 10^{-3}$ sec. (Arnot and Milligan's excited mol.; cf. A., 1936, 410) are formed by multiple impacts between the at. ions produced in the arc and neutral Hg atoms, and that these particles dissociate to produce the excited atoms which radiate the afterglow.

N. M. B.

Appearance of neon spark lines under the influence of an external magnetic field. Y. Morimoto (*J. Sci. Hiroshima Univ.*, 1940, A, 10, 253—259; *Rev. Phys. Chem. Japan*, 1941, 15, 62).—When the SiO_2 capillary of a Geissler tube containing pure Ne is set transversely between the poles of an electromagnet the intensity of the Ne I lines increases even

in a weak field but the Ne II spectrum appears only in stronger fields, attaining a max. in a field of ~ 7000 gauss. With application of the strong transverse field the length of the needle spark gap across the electrodes of the tube is increased to a val. > that required in the absence of the tube.

J. W. S.

Zeeman effect of the forbidden lines of Pb I. II. Interference effect in the mixed line $\lambda 7330$. F. A. Jenkins and S. Mrozowski (*Physical Rev.*, 1941, [ii], 60, 225—233; cf. A., 1941, I, 309).—The transverse Zeeman effect of this line, which contains mixed magnetic dipole and electric quadrupole radiation, is investigated with a Fabry-Perot interferometer, and with magnetic fields > 4000 gauss. The pattern obtained accords with expectations. Quant. intensity measurements of all components are reported. The relative intensities of the π components and of the three central magnetic dipole components agree with the theory of Gerjuoy (cf. following abstract) if account is taken of the intensities contributed by the Zeeman components of the hyperfine structure. These components are investigated at various magnetic fields, and the development of the Back-Goudsmit effect is verified. Comparison of measured and theoretical intensities of the π components indicates $2.2 \pm 0.5\%$ of quadrupole radiation, and proves that interference exists between the two types of radiation.

N. M. B.

Interference in the Zeeman effect of forbidden lines. E. Gerjuoy (*Physical Rev.*, 1941, [ii], 60, 233—240).—Mathematical. Formulae are developed for the intensities of Zeeman components, taking into account the possibility of simultaneous electric quadrupole and magnetic dipole radiation and interference between these two modes of radiation. Such additional interference terms appear only in the Zeeman effect and not in total line intensities. Formulae are compared with observed data for Pb I (cf. preceding abstract). The quadrupole moment of the transition electron in Pb I, based on observed Zeeman effect and as computed from comparison of total line intensities, has a val. in both cases very much < that given by a rough estimate from screening const. data. The hyperfine structure of forbidden lines is briefly discussed.

N. M. B.

Paschen-Back effect. VIII. Reality of the distant components. J. B. Green (*Physical Rev.*, 1941, [ii], 60, 343—344; cf. A., 1936, 653).—An investigation of the He line $\lambda 7066$ shows that the distant components, of extremely small predicted intensity, actually exist. Positions and intensities show good agreement with theory.

N. M. B.

Small-angle single scattering of electrons. W. Bothe (*Naturwiss.*, 1940, 28, 239—240).—The analysis of scattering determinations is simpler if the scattering is limited to small angles. The ratio of the scattering cross-section on the Rutherford-Mott theory to that calc. by a formula deduced has been obtained for Al and Ni. The determinations can be satisfactorily explained by assuming an attractive force equal to ar^{-n} , where n lies between 4 and 6, in addition to the Coulomb force.

A. J. M.

Localisation of the discharge in ordinary and canal-ray tubes. V. T. Chiplonkar (*Proc. Indian Acad. Sci.*, 1940, 12, A, 440—452).—The radial distribution of current on the surface of the cathode in a discharge tube has been investigated by using a sectorial cathode. The distribution is examined as a function of the applied voltage and of the length of the cathode dark space, in O_2 , H_2 , N_2 , and air. There is, in general, a concn. of current in the centre of the cathode in the range of voltages used. For a given gas the localisation is independent of the applied voltage and the

discharge current, and is determined by the length of the cathode dark space, increasing with the latter and reaching a stationary val. for very high lengths (~ 5 cm.). In the case of canal-ray tubes the results are the same as for ordinary discharge tubes, except when the tube is filled with H_2 .

A. J. M.

Montgomery theory of counter discharge. W. E. Ramsey and W. L. Lees (*Physical Rev.*, 1941, [ii], 60, 411).—Further confirmation of the theory (cf. A., 1940, I, 306) is given by consideration of a series of curves showing the variation of pulse size with counter length for various vals. of wire capacity.

N. M. B.

Isotopic weight of ^{12}C . K. Ogata (*Proc. Phys.-Math. Soc. Japan*, 1940, III, 22, 486–491; *Rev. Phys. Chem. Japan*, 1941, 15, 54).—Recalculation from the principal doublets measured by Aston, Bainbridge and Jordan, Mattauch, and Ogata leads to mean vals. of $1.008131 \pm 0.033 \times 10^{-4}$, $2.014723 \pm 0.066 \times 10^{-4}$, and $12.003871 \pm 0.33 \times 10^{-4}$ for the masses of 1H , 2D , and ^{12}C , respectively.

J. W. S.

Isotopic constitution of cobalt. J. J. Mitchell, H. S. Brown, and R. D. Fowler (*Physical Rev.*, 1941, [ii], 60, 359).—Considerations throwing doubt on the existence of ^{60}Co (cf. Sampson, A., 1937, I, 4) are discussed. The curve obtained from a mass-spectrometer analysis of Co showed no trace of a peak for ^{60}Co , indicating that if it exists the abundance must be < 1 in 30,000 of ^{60}Co . A study of the $CoCl^+$ ions showed no peak at 92. An 11-min. activity cannot be due to ^{60}Co , hence that activity is probably isomeric with the 7-year activity ascribed to ^{60}Co .

N. M. B.

Masurium—element 43. J. G. F. Druce (*Chem. and Ind.*, 1941, 729–730).—A review.

A. J. E. W.

Multiple scattering of fast electrons. N. L. Oleson, K. T. Chao, and H. R. Crane (*Physical Rev.*, 1941, [ii], 60, 378–385).—A cloud-chamber study was made of the scattering of fast electrons (3–11 Me.v.) by C, Cu, Fe, Cd, and Pb in the form of foils of such thickness that the resultant average deflexion was chiefly due to many small-angle deflexions, thus allowing a comparison of the Williams (cf. A., 1940, I, 399) and Goudsmit–Saunderson (cf. *ibid.*, 336) theories of multiple scattering. Results indicate that at either end of the at. no. scale, scattering is $<$ predicted by theory, but immediately there is good agreement. No effect of crystal size on scattering could be detected.

N. M. B.

Scattering of electrons from radium-E by thin metal foils. J. L. Saunderson and O. S. Duffendack (*Physical Rev.*, 1941, [ii], 60, 190–197).— β -Rays of energy > 0.2 Me.v. from Ra-E were scattered by thin foils of Al, Cu, Ag, or Au and the distribution of the scattered electrons was measured with a Geiger–Müller counter at angles 0 – 45° . The thickness of the thinner set of foils was such that each had the same cross-section for single scattering, and the second set was twice as thick. The Wentzel angle was 22° for the first set and 33° for the second. Results indicate that such deviations from the Mott formula as exceed experimental error are due to the effects of multiple scattering and the inadequacy of the Wentzel criterion for elements of small at. no.

N. M. B.

Fermi theory of β -radioactivity. II. “Forbidden” spectra. E. J. Konopinski and G. E. Uhlenbeck (*Physical Rev.*, 1941, [ii], 60, 308–320).—Mathematical. Fermi’s theory of the energy distribution of β -particles is extended to first and second forbidden transitions for arbitrarily charged nuclei. Calculations are made for the original “polar vector” and for the scalar, tensor, axial vector, and pseudo-scalar forms of the theory. Selection rules appropriate for these are tabulated, and final results are given in the form of a correction factor by which the allowed distribution must be multiplied to give a forbidden spectrum. Results are compared with experimental data for ^{24}Na , ^{32}P , and Ra-E. Energy distribution evidence favours the tensor and polar vector theories equally, but the former is probably preferable since it leads to Gamow–Teller selection rules.

N. M. B.

Antisymmetrical interaction in β -decay theory. C. L. Critchfield and E. P. Wigner (*Physical Rev.*, 1941, [ii], 60, 412–413).—Considering β -disintegration as a four-particle process, there is a totally antisymmetric relativistically invariant interaction which can be used instead of Fermi’s original “vector interaction.” In terms of the customary five invariants (heavy particle covariants contracted on light particle contravariants) the antisymmetric interaction is a

sum of scalar, axial vector, and pseudoscalar invariants. Qual. aspects of allowed and forbidden transitions under this theory are discussed.

N. M. B.

β -Ray energy of 3H . R. D. O’Neal (*Physical Rev.*, 1941, [ii], 60, 359–360).—The val. previously reported (cf. A., 1940, I, 426) is 15 ± 3 ke.v. compared with Brown’s val. 9.5 ± 2 ke.v. (cf. A., 1941, I, 359). Since the discrepancy is in the use of the range-energy relations, data for the former val. are reported.

N. M. B.

Resonance capture of slow neutrons and γ -rays. I. Nonaka (*Mazda Kenkyu Jiho*, 1940, 15, 1–8; *Rev. Phys. Chem. Japan*, 1941, 15, 61).—In the capture of slow neutrons by at. nuclei which become radioactive, the existence and energy of group neutrons of resonance capture have been determined by investigation of the γ -ray emitted. By interposing a paraffin plate between D–D neutron source and the sample (Fe, Cd, Hg, Bi) the relation between γ -ray intensity and plate thickness was examined.

J. W. S.

Relative number of γ -ray quanta emitted per capture of a thermal neutron. I. Nonaka (*Mazda Kenkyu Jiho*, 1940, 15, 310–314; *Rev. Phys. Chem. Japan*, 1941, 15, 62).—The relative no. of γ -ray quanta emitted per capture of a thermal neutron is determined as 0.64, 0.74, 1.00, and 0.82 for Cl, Ag, Cd, and Hg, respectively. These vals. are in accord with previous determinations and with the vals. calc. from the binding energy of a neutron to the nucleus.

J. W. S.

Angular distribution of fast neutrons scattered by atoms. III. T. Wakatuki (*Proc. Phys.-Math. Soc. Japan*, 1940, III, 22, 430–441; *Rev. Phys. Chem. Japan*, 1941, 15, 62).—The scattering of D–D and Li–D neutrons by H, C, Al, Fe, Sn, and Pb has been investigated. The differential scattering cross-section for 3-Me.v. neutrons has a max. at $\sim 20^\circ$ for most elements except H, but this max. does not appear in the scattering of Li–D neutrons. The results are discussed in conjunction with previous data and it is inferred that a very marked anisotropy is necessary to account for them.

J. W. S.

Forward scattering of neutrons by paramagnetic media. M. D. Whitaker and W. C. Bright (*Physical Rev.*, 1941, [ii], 60, 280–281).—Measurements on differential scattering of slow neutrons at small angles by $MnSO_4$ and MnF_2 fail to support the suggestion of Halpern (cf. A., 1940, I, 143) that the magnetic moment of the neutron may be 6 units. Any scattering, in addition to nuclear scattering, in the forward angular region studied is $>$ equiv. to 5 units (10^{-24} sq. cm.) of cross-section in this region, and this is only $\sim 25\%$ of that to be expected from a neutron moment of 2 nuclear magnetons.

N. M. B.

Width of the level Ag^{22+} . D. V. Timoschuk (*J. Physics U.R.S.S.*, 1940, 3, 81–82).—The proper breadth of the Ag^{22+} level has been compared with the change in Doppler breadth between room temp. and liquid N_2 temp. by measurements of the absorption of Ag resonance neutrons (group A), giving an effective breadth 0.4 e.v. for the Ag^{22+} level. Measurements of the retardation of resonance electrons scattered by heavy nuclei gave results in agreement. The total true width found is 0.14 ± 0.02 e.v.

L. J. J.

Angular distribution of photoneutrons (Ra–Th + Be). T. A. Goloborodko (*J. Physics U.R.S.S.*, 1940, 3, 141–142).—The angular distribution of neutrons emitted by Be irradiated with Ra–Th is closely similar to that obtained with Ra–Th + D, and differs markedly from the spherical-symmetrical distribution obtained with Ra + Be.

L. J. J.

Relative cross-sections of the (n, α) and (n, p) reactions produced by fast neutrons. T. Amaki and A. Sugimoto (*Sci. Papers Inst. Chem. Res. Tokyo*, 1941, 38, 377–381; cf. A., 1941, I, 2).—These are studied, using induced radioactivities, for some elements lighter than Zn. The results are somewhat complicated and do not admit a simple interpretation. It is concluded that, according to the elements and to the energy of neutrons, there is a wide range of variation in the relative cross-sections \gg the error of measurement.

O. D. S.

Slowing down of neutrons by elastic collisions. F. Adler (*Physical Rev.*, 1941, [ii], 60, 279–280).—Mathematical. An equation is derived for $M(E)dE$, where M is the mass of the nuclei of a homogeneous medium in which neutrons are produced and scattered by an elastic collision into the energy interval dE at E .

N. M. B.

Pair emission of fluorine when bombarded with protons. T. Sexl (*Naturwiss.*, 1940, 28, 255).—The excitation function of the electron-positron pairs emitted when F is bombarded with protons shows resonances which are in no way connected with those of the γ -emission which occurs simultaneously. The pairs are thus primary and not secondary products. They may arise from the ^{19}F nuclei, produced intermediately from $^{19}\text{F} + ^1\text{H}$, in which a proton falls from an excited to a lower state, and thence gives an electron-positron pair via the virtual emission of a neutral Yukawa particle. A. J. M.

γ -Rays from sodium bombarded by protons. R. L. Burling (*Physical Rev.*, 1941, [ii], 60, 340—343; cf. Curran, A., 1939, I, 546).—Measurements of γ -ray intensity as a function of energy are plotted for proton energies >1.9 Me.v. The reaction is $^{23}\text{Na} (p, \gamma) ^{24}\text{Mg}$. Reproducible curves for thin and thick Na films are given; they show 21 well-defined resonances. N. M. B.

Deuteron-induced fission in uranium and thorium. D. H. T. Gant and R. S. Krishnan (*Proc. Roy. Soc.*, 1941, A, 178, 474—492).—The active deposit technique was used to study the fission of U and Th by deuterons of 9 Me.v. The range of the fission fragments was found to be ~ 2.3 cm. in air for both U and Th; the decay curve is of the type to be expected from a complex mixture of radioactive bodies. The active deposit was examined for emission of β -rays, positrons, γ - and X-rays, α -particles, and neutrons; the radiations found resemble those due to neutron-induced fission. Some of the radioactive bodies were isolated by chemical methods and some correspondence with the products of neutron-induced fission was found. The ratio of the fission cross-section for 9-Me.v. deuterons and (Li + D) neutrons was measured and the excitation function was studied. G. D. P.

Deuteron bombardment of the heavy elements. II. Platinum. R. S. Krishnan and E. A. Nahum (*Proc. Camb. Phil. Soc.*, 1941, 37, 422—432; cf. A., 1941, I, 3).—Pt has been bombarded by deuteron beams up to 6 μa , and ~ 9 Me.v. and the products chemically separated into Pt and Au fractions. The activities of the products and the absorption of emitted β -particles in Al and emitted γ -rays in Pb have been measured. Activities due to the following were observed: ^{190}Pt , 32-min. half-life, formed by $^{188}\text{Pt} (^2\text{H}-^1\text{H})$; ^{190}Pt decaying to active ^{190}Au by emission of continuous β -rays; ^{197}Pt , 18 hr., formed by $^{195}\text{Pt} (^2\text{H}-^1\text{H})$; ^{197}Pt ; 2.8-day Pt, probably either a metastable excited state of a stable isotope of Pt or an activity due to K-electron capture in an unstable isotope ^{192}Pt ; ^{192}Au , 2.6 days, formed by both ^{190}Pt (32 min.) $\rightarrow ^{192}\text{Au} + e^-$, and $^{188}\text{Pt} (^2\text{H}-^1\text{H})$; ^{190}Au ; 5.6-day Au, probably either ^{190}Au or ^{197}Au . A weak activity of longer period in the first Au fraction was observed but not further investigated. No evidence was obtained of the formation of active isotopes of Ir during the bombardment. Excitation-function measurements have been made for the 32-min. and 18-hr. Pt isotopes. The form of the energy yield curve is the same for both elements. It lies between the curves deduced for the Gamow and the Oppenheimer-Phillips processes respectively and close to the latter. O. D. S.

Half-life of ^{14}C . A. K. Solomon (*Physical Rev.*, 1941, [ii], 60, 279; cf. Conant *et al.*, A., 1941, III, 380).—Measurements on ^{14}C as BaCO_3 , with an alcohol-filled Geiger-Müller counter and a scale-of-16 circuit are reported. The mean val. is 20.42 ± 0.06 min. N. M. B.

Energies of γ -rays from ^{82}Br , ^{131}I , ^{130}I , ^{56}Mn , ^{54}Mn , ^{74}As . M. Deutsch and A. Roberts (*Physical Rev.*, 1941, [ii], 60, 362).—Measurements, with a "short magnetic lens" spectrometer, of internal conversion, photo-electrons (for energies $> \sim 1.4$ Me.v.), and Compton electrons (for energies > 1 Me.v.) gave the following γ -ray energies (in Me.v.): ^{82}Br (36 hr.) 0.547, 0.787, 1.35; ^{131}I (7.8 days) 0.367 ± 0.007 ; ^{130}I (12.6 hr.) 0.417, 0.535 ± 0.01 , 0.670, 0.740; ^{56}Mn (2.6 hr.) 0.832, 2.20; ^{54}Mn (310 days) 0.850, 0.120; ^{74}As (17 days) 0.582. N. M. B.

Scattering of protons by magnesium and aluminium. T. R. Wilkins (*Physical Rev.*, 1941, [ii], 60, 365—373).—A new type of nuclear scattering camera with photographic emulsions to determine no. and energy of scattered protons at many sharply defined angles is described and compared with other arrangements. The effects of various factors in producing straggling of the scattered particles are surveyed. Data for

the angular distributions of elastically and inelastically scattered proton groups are given, and the former compared with Rutherford scattering. Excited states of Mg nuclei occur at 1.37, 2.80, and 4.07 Me.v. N. M. B.

New reactions in nickel. R. L. Doran and W. J. Henderson (*Physical Rev.*, 1941, [ii], 60, 411—412).—Curves of log half-life-at. no. (cf. Dickson, A., 1941, I, 68) predict the half-lives ^{57}Ni (~ 2 min.) and ^{59}Ni (~ 36 hr.). The 36-hr. activity and a 2-min. and 2.6-hr. (known to be ^{62}Ni) activity were produced by a fast neutron reaction on Ni. Bombardment of Fe by α -particles showed the 2-min. and 36-hr. activities produced by the reactions $^{54}\text{Fe} (a, n) ^{57}\text{Ni}$ and $^{56}\text{Fe} (a, n) ^{59}\text{Ni}$. Long bombardment of Ni by slow neutrons and deuteron bombardment of Ni produced the 36-hr. activity by the reactions $^{58}\text{Ni} (n, \gamma) ^{59}\text{Ni}$ and $^{58}\text{Ni} (d, p) ^{59}\text{Ni}$. Hence the 2-min. activity must be due to $^{54}\text{Fe} (a, n) ^{57}\text{Ni}$ and $^{56}\text{Ni} (n, 2n) ^{57}\text{Ni}$. N. M. B.

γ -Radiation from long-lived yttrium. J. R. Richardson (*Physical Rev.*, 1941, [ii], 60, 188—190; cf. Du Bridge, A., 1940, I, 340).—The energy distribution of the γ -radiation from Y (100 days) was investigated by measuring the momentum distribution of the recoil electrons from a thin paper radiator near the centre of a cloud-chamber. The distribution falls into two groups corresponding with γ -ray energies of 0.95 ± 0.05 and 1.92 ± 0.03 Me.v. The relative no. of quanta in the γ -ray lines is 1:0.9. N. M. B.

Disintegration of slow mesotrons. F. Rasetti (*Physical Rev.*, 1941, [ii], 60, 198—204; cf. A., 1941, I, 316).—In order to determine the mean life of the decay process and to decide whether all or only half of the slow mesotrons undergo spontaneous disintegration, the absorption of a mesotron by a block of Al or Fe was recorded by a system of coincidence and anti-coincidence counters. Another system of counters and circuits registers the delayed emission of a particle, which is interpreted as the disintegration electron associated with the absorbed mesotron. From the time distribution of the emitted particles the mean life of the decay process is $1.5 \pm 0.3 \mu\text{-sec.}$, in agreement with the val. deduced from the atm. absorption effect. The abs. no. of disintegration electrons per absorbed mesotron is ~ 0.5 , according with theoretical predictions that positive mesotrons undergo spontaneous decay, and negative ones react with nuclear particles. N. M. B.

Transformation effect of neutral mesotrons. Y. Nishina, K. Birus, Y. Sekido, and Y. Miyazaki (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, 38, 353—359).—An arrangement of four counters, or counter systems, has been set up in which the second counter system is separated from both the upper and the lower two systems by a 1.5-m. thickness of Fe. The no. of triple coincidences between the first, third, and fourth counters when a bundle of cosmic rays falls perpendicular to the counters is compared with the no. of fourfold coincidences. Corr. vals. show a very small preponderance of triple over fourfold coincidence which may be ascribed to the transformations: $\gamma^- + p \rightleftharpoons n + \gamma^0$, and $\gamma^+ + n \rightleftharpoons p + \gamma^0$, occurring in the Fe screens with the effect that some charged mesotrons registering in counter 1 are rendered neutral and do not register in counter 2, but on passing the second Fe filter take part in the reverse transformation and register in counters 3 and 4. The mean free path of charged and neutral mesotrons for this transformation is calc. to be < 10 m. Fe, and the transformation cross-section $> 3 \times 10^{-28}$ sq. cm. O. D. S.

Neutral mesons in cosmic rays? Y. Nishina and K. Birus (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, 38, 360—370).—Arley and Heitler's suggestion (A., 1938, I, 429) that Maass' effect (A., 1937, I, 6) is due to neutral mesotrons in cosmic rays has been disproved experimentally. It is shown that the particles producing the effect excite discharge in a counter before passing through an Fe filter. The effect described by Nishina *et al.* (preceding abstract) may be due to scattering or secondary excitation. There is therefore no evidence for neutral mesotrons in cosmic rays. O. D. S.

Second maximum of the Rossi curve. L. Broussard and A. C. Graves (*Physical Rev.*, 1941, [ii], 60, 413).—In view of discordant available data by counters on the height of the max. and angular divergence of showers responsible for the max., a curve was obtained by cloud-chamber measurements. The curves for total showers and for two-particle showers with angular divergence $> 20^\circ$ show well-defined max. at

~17 cm. of Pb. Insufficient narrow-angle showers for constructing a curve were obtained. N. M. B.

Production of mesotrons by ionising radiation. W. M. Powell (*Physical Rev.*, 1941, [ii], 60, 413—414).—In 3881 random expansions of a large Wilson cloud chamber containing five horizontal 1-cm. Pb. plates, one photograph can be interpreted as the production by a heavy particle of a shower containing ≤ 4 heavy particles. Other tracks in the photographs are discussed. N. M. B.

Cloud-chamber photograph of slow mesotron pair. D. J. Hughes (*Physical Rev.*, 1941, [ii], 60, 414).—In 5000 photographs in a field of 1165 gauss at 15,500 ft. altitude, one photograph showed a positive-negative pair of heavily ionising particles. Preliminary measurements show for the negative particle $H\rho = 1.03 \times 10^5$ gauss cm.; its ionisation is ~ 4 —6 times the electronic min., and the corresponding calc. mesotron mass is 160—196 electron masses. The ionisation density, being very nearly that of the knock-on electron, gives the ionisation val. 4.5; a val. equal to this for the mesotron gives a mass of 170. The energy is 34 ke.v., and the angle of ejection 50—60°, giving a mesotron mass of 189 ± 24 . Data for the positive particle are similar but less accurately determined. Results indicate the creation of a pair of slow mesotrons (~ 5 Me.v.) in the gas or glass wall of the cloud chamber. N. M. B.

Dipole character of the meson, and difficulties of meson theory. D. Ivanenko and A. Sokolov (*Physical Rev.*, 1941, [ii], 60, 277—278).—Mathematical. The factor $(\hbar v/\mu c^2)^2$ appearing in the ultra-relativistic meson formulae and characterising the general behaviour of mesons depends on the effective dipole character of the mesons. Considerations supporting this view and illustrating the validity of the factor are reviewed and discussed. Difficulties arising from the application of Proca equations, contributions by mesons to the non-linearities in Maxwell's electrodynamics, and damping effects are examined. N. M. B.

Classical mesodynamics. D. I. Ivanenko and A. Sokolov (*J. Physics U.R.S.S.*, 1940, 3, 57—64).—A general solution of the Proca equations for a meson field is given on classical lines. The scattering and interaction of mesons are discussed. The increase of cross-section for the quasi-magnetic scattering is considered. A. J. M.

Compton effect of the mesotron. J. Smorodinski (*J. Physics U.R.S.S.*, 1940, 3, 143—147).—The scattering effect of a free mesotron on light of λ of the order of the classical radius of the mesotron is calc. L. J. J.

Reciprocity. VI. Wave function of the meson. K. Sarginson (*Proc. Roy. Soc. Edin.*, 1941, 61, 77—92).—Mathematical. O. D. S.

Conception of exchange energy in quantum mechanics. S. Flügge (*Naturwiss.*, 1940, 28, 673—677).—The meaning of exchange energy is made clear by considering the mechanics of coupled pendulums. A. J. M.

Energy production in red giants. M. A. Greenfield (*Physical Rev.*, 1941, [ii], 60, 175—183; cf. Bethe, A., 1939, I, 237).—Evolutionary changes in stars producing their energy by thermonuclear reactions of light elements are studied by the method of homology transformations. Formulae are developed for the luminosity and radius of the star as a function of time, and for the gravitational contraction of the star in the transitional stages between nuclear reactions. Regions in which either the contraction or the nuclear reactions predominate are correlated with various known groups of pulsating stars, thus permitting a definite nuclear reaction to be ascribed to each group. N. M. B.

Rare-earth and transuranic elements. M. Goepfert-Mayer (*Physical Rev.*, 1941, [ii], 60, 184—187; cf. McMillan, A., 1940, I, 340).—The possible existence of a rare-earth-like group of elements from U to the transuranic elements is discussed by a calculation of the at. eigenfunctions of the 4f and 5f electrons. Energy and spatial extension of the 4f eigenfunctions drop suddenly at the beginning of the rare-earth group; the calc. binding energy is 0.95 e.v. in ^{57}La and 5 e.v. in ^{60}Nd . The 5f eigenfunctions change similarly at $Z \sim 92$. Calc. binding energies are 1.35 for $Z = 86$, 8.5 for $Z = 91$, and 14 e.v. for $Z = 93$. N. M. B.

Nuclear surface energy. E. Feenberg (*Physical Rev.*, 1941, [ii], 60, 204—207).—Mathematical. The eigenvalues of a

free particle in a spherical potential well of finite depth are computed and used to calculate the surface energy of nuclear systems. For depth $56mc^2$ and radius $\frac{1}{2}A^{1/2}/mc^2$ the calc. surface energy is $\sim 66\%$ of the empirical val. $26.41mc^2$ required by the empirical packing fraction curve and the phenomenon of fission. A well of infinite depth yields a surface energy $>$ twice the empirical val. One-dimensional and cubical wells are discussed for the purpose of orientation. N. M. B.

Theory of the magnetron. I. L. Brillouin (*Physical Rev.*, 1941, [ii], 60, 385—396).—Mathematical. A complete calculation of space charge and field repartition for a magnetron working under steady conditions is given. Electrons leaving the filament gradually acquire an angular velocity, and, for distances $> L$, describe spirals around the filament. L is given by $L^2 = -eI/m\omega_H^2$, where I = current per unit length of filament, and ω_H = Larmor's angular velocity. Under crit. conditions, i.e., when the magnetic field is just high enough to cut the anodic current I , the electron cloud rotates about the filament almost as a solid body with angular velocity ω_H . Small oscillations with cylindrical symmetry have a proper frequency $\sqrt{2}\omega_H$, and the magnetron is able to yield an internal negative resistance for certain frequency bands near $\sqrt{2}\omega_H$; this explains how a magnetron with one cylindrical anode can sustain continuous oscillations in an electric circuit. N. M. B.

Electrodynamics of anisotropic medium. V. L. Ginzburg (*J. Physics U.R.S.S.*, 1940, 3, 95—100).—A general method, based on the Hamilton method, of calculating the radiation emitted by an oscillator in an anisotropic medium is described. L. J. J.

Radiation of an electron moving in a crystal with a constant velocity exceeding that of light. V. L. Ginzburg (*J. Physics U.R.S.S.*, 1940, 3, 101—106; cf. preceding abstract).—The method already described is applied to the case of an electron moving in a crystal with velocity $>$ that of light. Two non-circular cones of radiation are produced, in which the intensity is not the same on different generatrices. The polarisation of the radiation differs from that in an isotropic medium. L. J. J.

Reflexion of electromagnetic waves by a layer with negative dielectric constant. S. M. Ritov and F. S. Judkevitch (*J. Physics U.R.S.S.*, 1940, 3, 111—124).—The wave-distribution produced when a plane electromagnetic wave impinges on a plane layer with negative dielectric const. (ϵ) without sharply defined boundaries is deduced by geometrical optical considerations and by integration of the wave equation for a model of such a layer. For the case of total reflexion and small ϵ gradients, the electrical wave is intensified immediately in front of the layer. This effect explains the non-linear effects found in the ionosphere, notably the Luxemburg effect. L. J. J.

II.—MOLECULAR STRUCTURE.

Effect of mercury vapour on the continuous spectrum of hydrogen excited by canal rays of hydrogen. V. T. Chiplonkar (*Indian J. Physics*, 1941, 15, 53—57).—Hg vapour profoundly affects the relative intensity distribution of the H_2 continuum especially at high operating voltages. Possible explanations are discussed. W. R. A.

New bands in the triplet carbon system [of CO]. R. K. Asundi (*Proc. Indian Acad. Sci.*, 1940, 12, A, 491—493).—Three new bands on the higher- λ side of the "triplet C" system of CO have been recorded. These new bands fit into the existing v' , v'' table, but require an increase of 2 units in the present v' quantum nos. The origin of the system is shifted to 13310.7 cm^{-1} , and may be still further in the region of longer λ . The $d^3\Pi_1$ level is at 61785.5 cm^{-1} above the ground level of CO. A. J. M.

Abundances of molecules in the solar reversing layer. R. H. Lyddane, F. T. Rogers, jun., and F. E. Roach (*Physical Rev.*, 1941, [ii], 60, 281—282; cf. A., 1939, I, 239).—Recalc. vals. for OH, CN, NH, CH, and C_2 are reported and compared with experiment. Abundances of CN and C_2 are appreciably $<$ those of the hydrides. N. M. B.

Vibrational analysis of CD and CH bands in the region 2260—2500 Å. L. Gerö and R. F. Schmid (*Physical Rev.*, 1941, [ii], 60, 363; cf. A., 1941, I, 237).—A vibrational scheme is tabulated for a newly discovered system of ten red-degraded bands,

which includes two bands at 2264 and 2367 Å. in CH_4 previously reported by McDonald (cf. A., 1928, 1304). This system, which is produced by condensed discharges in He containing a small amount of C_2H_4 , is comparable with another new system produced in condensed discharges in He containing a small amount of heavy paraffin vapour. The probable emitters of the systems are CH^+ and CD^+ respectively. N. M. B.

Structure of the electronic bands of the OD molecule. I. M. G. Sastry and K. R. Rao (*Indian J. Physics*, 1941, 15, 27—51).—OD bands have been photographed in discharges through vapour of D_2O and the rotational structures of the (1, 0), (2, 1), and (3, 2) bands have been determined. Rotational consts., the spin coupling const., vibrational consts., and the mass ratio of the H_2 isotopes are computed.

W. R. A.

Structure of electronic bands of polyatomic molecules. I. Prolate approximation for XY_2 molecules. N. Metropolis (*Physical Rev.*, 1941, [ii], 60, 283—294; cf. Mulliken, A., 1941, I, 319).—The four characteristic cases of changes in dimensions during the electronic transition are considered; they yield four typically different band structures. The variation in band structure with bond distance and apex angle is worked out for SO_2 mols. and theoretical quant. band-structure diagrams for 200°K . are given. Results can be generalised to mols. in which the moments of inertia of the ground and upper states, respectively, have the same ratio as those in SO_2 . Rotational structure and vibrational intensity distribution are correlated, leading to conclusions on changes in dimensions of the XY_2 mol. in the transition. Available data on SO_2 and ClO_2 are compared. N. M. B.

Vibrational analysis of the absorption system of sulphur dioxide at λ 3400—2600. N. Metropolis (*Physical Rev.*, 1941, [ii], 60, 295—301; cf. preceding abstract).—The bands were photographed under low, medium, and high dispersion, at room temp. and at 200°K , with absorbing gas pressures 0.3—480 mm. An expression from 30 bands is found. Twelve bands corresponding with transitions from excited vibrational levels in the normal state have been identified. The vibrationless transition at 29622 cm^{-1} is weak, as expected from the Franck-Condon principle. Substitution of the three fundamental frequencies ($\nu_1' = 794$, $\nu_2' = 345$, $\nu_3' = 833 \text{ cm}^{-1}$) in the formula based on a valency force model gives 100° for the apex angle in the excited state, compared with 120° in the normal state. There is evidence that the mol. in its upper state has become a more asymmetrical top. N. M. B.

Continuous emission spectra associated with electric discharges through flowing vapours of SnCl_2 , SnCl_4 , and SiCl_4 . R. K. Asundi, S. M. Karim, and R. Samuel (*Proc. Indian Acad. Sci.*, 1940, 12, A, 513—518).—Spectra previously reported (cf. A., 1938, I, 431) are assumed to be due to mol. radiation. The relation between the energy levels of the various systems in the formation of the polyat. mols. from their constituent atoms is illustrated from thermochemical and spectroscopic data, and simplified Franck-Condon diagrams are constructed. A uniform interpretation of the observed continuous bands in terms of the transitions among the energy levels, involving a repulsive state for their final level, is suggested. N. M. B.

Optical investigation of the intramolecular hydrogen bond. M. Batuev (*J. Phys. Chem. Russ.*, 1940, 14, 1064—1073).—The presence or absence of the absorption band at 1.4μ is no reliable indication of the absence or presence of H bond as the behaviour of other OH bands can differ from that of 1.4μ . Combination spectrum gives more reliable information. The OH band of PhOH at 45° has no max. and extends from 3291 to 3531 cm^{-1} ; that of $p\text{-C}_6\text{H}_4\text{Cl-OH}$ at 25° is similar and lies between 3287 and 3557 cm^{-1} . In both these cases associated complexes are present. The OH bands of PhOH at 200° and of $o\text{-C}_6\text{H}_4\text{Cl-OH}$ at 25° have max. at 3567 and 3522 cm^{-1} respectively, showing that unassociated OH groups are preponderant. J. J. B.

Spectrum of the explosion flame of gaseous azoimide and its mixture with mercury vapour. I. M. Tolmatshev (*J. Phys. Chem. Russ.*, 1940, 14, 615—627).—When HN_3 at 15 mm. Hg is ignited by a spark $3\text{N}_2 + \text{H}_2$ and almost no by-products are formed, the emission spectrum contains chiefly NH bands, which are responsible for $>40\%$ of the light inten-

sity. When HN_3 is mixed with Hg vapour (0.1—1.2 mm. Hg) Hg lines, especially 2536.5 Å., are observed. No HgN_3 or HgN_4 is formed in the gas, and the Hg lines must be due to fluorescence caused by collision with excited mols. The only binary collision which can supply enough energy for the line 2536.5 is that between excited NH_3 and Hg in the 6^1S_0 state. Four ternary collisions also can give rise to this line. No definite mechanism of the explosion can be deduced from the results; some probable mechanisms are discussed.

J. J. B.

Optical sensitisation of silver halides. VIII. Spectral photosensitivity and absorption of silver salts of phthalein dyes. S. V. Natanson (*J. Phys. Chem. Russ.*, 1940, 14, 989—995; cf. A., 1939, I, 620).—The max. of the light absorption of Ag erythrosinate (562 $\text{m}\mu$), Ag eosinate (550—555 $\text{m}\mu$), and Ag phloxinate (568—574 $\text{m}\mu$) coincide with those of AgBr sensitised by erythrosin, eosin, and phloxin, respectively, and also with the max. of the photosensitivity of these salts in gelatin or agar. The absorption spectra of Ag erythrosinate etc. in gelatin are different from those in H_2O and agar, presumably because of a dissociation of these salts in gelatin. J. J. B.

Near ultra-violet absorption spectra of benzene and its derivatives. III. Phenol. K. Asagoe, Y. Shimokawa, and S. Kageyama (*Japan. J. Physics*, 1940—41, 14, 11—16).—The absorption spectrum of PhOH in the region 2500—2800 Å. is comparatively simple and the strongest band, at 36356 cm^{-1} , is assigned to the $0 \rightarrow 0$ transition. Const. frequencies of 779, 932, 982, 473, and 1272 cm^{-1} are commonly observed. On the long- λ side of the main bands progressions at $\sim 220 \text{ cm}^{-1}$ and $\sim 60 \text{ cm}^{-1}$ occur. Bands fall into five series. The data are compared with those for PhCl and PhBr. W. R. A.

Ultra-violet absorption spectra of N-phenylpyrazolones. III. 5-Methoxy-1-phenyl-3-methylpyrazole and 1-phenyl-3-methyl-5-pyrazolone. N. A. Valjaschko and V. I. Blizniukov (*J. Gen. Chem. Russ.*, 1941, 11, 23—40).—The absorption spectra of 5-chloro- and 5-methoxy-1-phenyl-3-methylpyrazole and of 1-phenyl-3-methyl-5-pyrazolone in *n*-hexane, EtOH, and EtOH-NaOH and -HCl are recorded. The spectra afford evidence of mesomeric changes of these compounds, the proportion of each mesomer in the equilibrium mixture depending on the nature of the solvent. R. T.

Absorption spectra of derride, isorotenone, malaccol, toxicarol, and sumatrol. T. M. Meijer (*Ingenieur in Ned.-Indië*, 1941, 7, 22—25).—Data for the above in EtOH solution are recorded and discussed. It is concluded that: (i) introduction of a OH group into the benzofuran nucleus causes a displacement of the main absorption max. to shorter λ ; (ii) introduction of a Pr β group into the furan nucleus causes a displacement of the main absorption max. to longer λ , and (iii) shift of the ethylenic linking from the furan ring to the Pr β causes a displacement of the main absorption max. to longer λ .

Absorption spectra of thiocyno-derivatives of 1:2-benzanthracene. R. N. Jones (*J. Amer. Chem. Soc.*, 1941, 63, 2528—2530).—Absorption max. and intensities for dioxan solutions are given for 15-thiocyno-20-methylcholanthrene and for 9-thiocyno-1:2-, 10-thiocyno-1:2- (I), 9-thiocyno-10-methyl-1:2- (II), and 10-thiocynomethyl-1:2-benzanthracene. The derivatives in which the CNS is not attached at position 9 have spectra similar to those of the unsubstituted hydrocarbons. The spectra of the 9-CNS-derivatives are different. This difference is probably attributable to steric effects, which are discussed. On irradiation of these compounds with ultra-violet only (I) and (II) fluoresce (bright green in solid state, blue in solution). W. R. A.

Luminescence, absorption, and scattering of light in diamonds. III. Absorption. P. G. N. Nayar (*Proc. Indian Acad. Sci.*, 1941, 14, A, 1—17; cf. A., 1941, I, 399).—Crystals of diamond absorb almost completely at $\sim 3000 \text{ Å}$. but a weak transmission is observed up to 2700 Å . Narrow line-like bands extend from 2700 to 3400 Å . and a system of diffuse bands, extending from 3600 Å . to longer λ , terminates in a sharp, intense band at 4156 Å . With rise in temp. all bands become more diffuse and practically disappear at 300° , whereas at low temp. the bands become sharp and shift to shorter λ . The intensity of the diffuse band system is directly related to fluorescence, and absorption and fluorescence $\nu\nu$ coincide at 4156 Å . Other diffuse bands are distributed with "mirror-image symmetry" about this line,

absorption bands on the short- λ and fluorescence bands on the long- λ side. The wave no. differences between these and the 4156 Å. line correspond with the $\nu\nu$ of weak infra-red bands. The probable origin of the band at 4156 Å. and the symmetrical pattern of bands around it are discussed.

W. R. A.

Scattering of light in crystals. (Sir) C. V. Raman (*J. Franklin Inst.*, 1941, **232**, 203—211).—A lecture, reviewing the mechanism of the Raman effect in crystals.

L. J. J.

Raman spectrum of sulphur. K. Venkateswarlu (*Proc. Indian Acad. Sci.*, 1940, **12**, A, 453—461).—The Raman spectrum of a single crystal of S consists of 9 frequencies at 84, 115, 156, 185, 217, 239, 440, 475, and 520 cm^{-1} , of which the first two are attributed to the lattice and the remainder are fundamentals of the S_8 mol. Selection rules for the infra-red absorption max. are given, and these max. are assigned to the mol. or the lattice, or are classed as combinations or overtones. No change in the intensity or frequency of the Raman lines is observed with increase of temp. from 30° to 150°. The total symmetric oscillations behave in a reciprocal manner to the degenerate oscillations.

A. J. M.

Raman spectra of crystalline nitrates and sulphates. B. L. Rao (*Proc. Indian Acad. Sci.*, 1941, A, **14**, 48—51).—The Raman spectra for single crystals of $M(\text{NO}_3)_2$ ($M = \text{Ba}, \text{Sr}, \text{Pb}$), $\text{MSO}_4 \cdot 7\text{H}_2\text{O}$ ($M = \text{Fe}, \text{Mg}, \text{Zn}, \text{Mn}$), and $\text{M}^{\text{III}}\text{M}^{\text{IV}}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ ($M^{\text{I}} = \text{K}, \text{NH}_4$; $M^{\text{III}} = \text{Al}, \text{Fe}$) have been investigated and new low-frequency lattice lines are reported. Displacements due to H_2O of crystallisation bear no correlation to the no. of mols. of H_2O nor to the crystal structure.

W. R. A.

Studies on internal rotation of ethane, propane, and butane derivatives by the Raman effect. N. Nakamura (*J. Chem. Soc. Japan*, 1939, **60**, 1010—1019; *Rev. Phys. Chem.*, 1941, **15**, 63).—The Raman spectra of liquid Pr^aCl , Pr^aBr , Pr^aI , Bu^aBr , $(\text{CH}_3)_2\text{OH}$, $\text{Cl}[\text{CH}_2]_2\text{OH}$, and $\text{Br}[\text{CH}_2]_2\text{OH}$ contain approx. twice as many lines as the Raman spectra of the solids, suggesting that two mol. species are present in the liquid and only one in the solid. The fact that the Raman spectra of solid and liquid $\text{I}[\text{CH}_2]_2\text{OH}$ are similar suggests that in this case there are two species even in the solid. A mol. model for Pr^a halides is suggested.

J. W. S.

Raman effect in ethane and butane. S. Nakamura and E. Kanda (*J. Chem. Soc. Japan*, 1939, **60**, 1275—1278; *Rev. Phys. Chem. Japan*, 1941, **15**, 63).—Solid and liquid C_4H_{10} at low temp. show 3 and 12 Raman lines, respectively, which can be attributed to chain vibration. This is interpreted as indicating that there exists in the solid the *trans*-form and the form obtained by rotation of 120° from the *trans*-form, whilst in the liquid frequent internal rotations occur around the C—C axis. The Raman line of liquid C_2H_6 has been measured between -140° and -150° .

J. W. S.

Raman effect of chloroprene in the course of polymerisation. E. D. Perumova (*J. Phys. Chem. Russ.*, 1940, **14**, 346—348).—The Raman spectrum of β -chlorobutadiene consists of $\nu\nu$ 3104, 3070, 3006 and 2967 due to CH_2 , $\nu\nu$ 1620 and 1574 due to C=C, $\nu\nu$ 1468, 1411, 1344, 1279 and 1206 due to C—H, ν 1006 due to C—C, $\nu\nu$ 722 and 612 due to C—Cl, and $\nu\nu$ 514, 435, and 242 due to C. Except the C—Cl frequencies the spectrum is identical with that of isoprene. Polymerisation shifts the frequency C=C from 1620 to 1626; no detailed observations can be made because of the turbidity of the polymerising liquid.

J. J. B.

Scattering of polarised light in colloids. D. Singh (*Proc. Indian Acad. Sci.*, 1940, **12**, A, 481—486).—The depolarisation of transversely scattered light by colloids having different particle size and shape has been investigated with incident light polarised in any azimuth. The results are compared with the vals. calc. from a formula due to Krishnan (A., 1940, I, 292). There is fairly good agreement for pure liquids, such as C_6H_6 and AcOH , and for As_2S_3 sols. For graphite, V_2O_5 , and Fe_2O_3 sols the calc. val. is usually > the observed val., but the opposite is the case for S sols. Experiments with graphite sols centrifuged for various times show that the deviation from theory becomes greater with increasing particle size and anisotropy. The causes of deviations may be the increasing prominence of secondary scattering with larger particles, the state of polarisation of which affects considerably the depolarisation factor of the sol, and the fact that with the larger anisotropic particles the assumption

that the components of the scattering which have the same direction of vibration are incoherent is no longer valid.

A. J. M.

Raman effect in potassium tartrate crystal. B. L. Rao (*Proc. Indian Acad. Sci.*, 1941, **14**, A, 41—42).—Raman displacements for a single crystal of K tartrate are recorded and compared with existing data on (i) crystal powder and 2M. aq. solution of K tartrate and (ii) Rochelle salt. Lattice $\nu\nu$ of 77, 103, and 150 cm^{-1} are reported.

W. R. A.

Structure of inorganic peroxides. I. A. Kazarnovski (*J. Phys. Chem. Russ.*, 1940, **14**, 320—331).—A review is given of the help rendered by physical calculations (e.g., of the energy of a bond) and measurements (e.g., of the Raman spectrum) to the investigation of the structure of H_2O_2 , BaO_2 , and K_2O_4 .

J. J. B.

Electrical resistance of single crystals of long-chain fatty acids. P. A. Thiessen, D. Beischer, and H. F. von Gillhausen (*Naturwiss.*, 1940, **28**, 265).—The structure of the crystals of long-chain fatty acids and their salts makes it likely that the conductivity perpendicular and parallel to the layer planes will be different. Actually the crystals do not conduct in either direction. Heating to the neighbourhood of the m.p. does not appreciably alter the resistance parallel to the layer planes. It is possible that quadrupole formation in these planes is so uniform that ionic or electronic motion under the influence of an external field is very difficult to bring about.

A. J. M.

Molecular layers as dielectrics of high breakdown potential. P. A. Thiessen, D. Beischer, and H. F. von Gillhausen (*Naturwiss.*, 1940, **28**, 265).—Multimol. layers of salts of long-chain fatty acids and proteins have been used as dielectrics between metal electrodes. Unimol. layers break down easily, but films of Ba and Cd stearates 100—1000 Å. thick will withstand a max. field of $4-5 \times 10^6$ v. per cm. The breakdown potential depends on the ionic concn., the length of the chain of the acid mol., the constitution of the mol., and the fine structure of the layer. The breakdown is a "thermal breakdown" at faults.

A. J. M.

Dielectric constants of ionised gases at medium radio-frequency. S. R. Khastgir and C. Choudhury (*Indian J. Physics*, 1941, **15**, 63—71).—The effective dielectric consts. (ϵ) of ionised air and He in discharge tubes have been measured at frequencies from 1100 to 375 kc. per sec. At const. frequency of measuring field, effective ϵ (slightly > 1) increases with increasing discharge current except where this is large. At const. discharge current, effective ϵ increases with increasing frequency of measuring field.

W. R. A.

Dipole moment of sulphanilamide and related compounds. W. D. Kumler and I. F. Halverstadt (*J. Amer. Chem. Soc.*, 1941, **63**, 2182—2187).—Dipole moments in dioxan at 25° are recorded: NH_2Ph 1.90, xenylamine (I) 2.07, PhSO_2NH_2 5.09, $p\text{-C}_6\text{H}_4\text{PhSO}_2\text{NH}_2$ 5.20, sulph- (II) 6.63, and metanilamide (IV) 5.63, $p\text{-NH}_2[\text{C}_6\text{H}_4]_2\text{SO}_2\text{NH}_2$ (III) 6.71 D. The vals. for NH_2Ph and (I) in dioxan are 0.3—0.4 D. > in C_6H_6 . The observed vals. for (II) and (III) are 0.81 and 0.69 D. > the vals. calc. on the assumption of no resonance. A form with a separation of charge must contribute appreciably to the structure of the mols. This conclusion is supported by comparing the calc. and observed vals. for $p\text{-NH}_2\text{C}_6\text{H}_4\text{CO}_2\text{Me}$. (IV) was of high purity and had m.p. $140-2^\circ$ (corr.).

W. R. A.

Effect of solvents on the internal rotation of carbonic esters. M. Yasumi (*J. Chem. Soc. Japan*, 1939, **60**, 1208—1224; *Rev. Phys. Chem. Japan*, 1941, **15**, 62—63).—The dipole moments (μ) of $\text{CO}(\text{OMe})_2$ and $\text{CO}(\text{OEt})_2$ have been determined between -40° and 70° from measurements on solutions in C_6H_6 , $n\text{-C}_6\text{H}_{11}$, and $n\text{-C}_8\text{H}_{18}$. In each case μ increases with rise in temp. The results are discussed in conjunction with data for the vapours and it is inferred that there is vibrational rotation of the partial dipole about the two C—O single linkings. Calculation of the electrostatic force and repulsive exchange force of the dipole suggests the probable existence of two kinds of stereoisomeride.

J. W. S.

Electrets made from dry-mixed components. W. J. Dodds and J. D. Stranathan (*Physical Rev.*, 1941, [ii], **60**, 360; cf. A., 1940, I, 41).—In the method described the powdered wax and rosin are sifted to a specified particle size, mixed in a mechanically driven mixer, and placed in an electrode-and-

tank system immersed in an oil-bath in which melting and cooling times are controlled. N. M. B.

Effect of pressure on the surface charge of an electret. G. E. Sheppard and J. D. Stranathan (*Physical Rev.*, 1941, [ii], **60**, 360—361).—Curves for surface charge density—time and surface charge—pressure are given and discussed for electrets prepared by the dry-mixed method (cf. preceding abstract). The pressure range is 10—288 cm. of Hg. The surface charge build-up shows an ageing effect. The limiting surface charge density is a linear function of pressure for pressures < 1 atm. N. M. B.

Refractive index of paraffins in terms of the number and frequency of the dispersion electrons. S. S. Kurtz, jun., and M. R. Lipkin (*J. Amer. Chem. Soc.*, 1941, **63**, 2158—2163).— n - ρ data for normal and average paraffins have been correlated by the equation $n^2 - 1 = B/[(v_0 + \phi)^2 - \nu^2]$ and there is approx. one dispersion electron per formula bond. In any homologous series the frequency $\propto \rho$. Provided ρ is known n can be calc. for any paraffin, any ν , any temp., and any pressure, to ± 0.0002 for normal and ± 0.0005 for average paraffins. W. R. A.

Spectroscopic examination of the diffraction of light by a thin metallic half-plane. N. Ananthanarayanan (*Proc. Indian Acad. Sci.*, 1941, **14**, A, 85—92).—The Fresnel diffraction due to thin Ag films bounded by a sharp edge has been examined spectroscopically. The visibility of the fringes follows closely the spectral distribution of intensity of the transmitted light. The fringes show a sudden bend with a point of inflexion in the region of selective transmission at 3200 Å. and are shifted towards the edge on the visible side and from the edge on the ultra-violet side. Intensity and phase curves for films of thicknesses 5×10^{-6} cm. and 10^{-5} cm. are given; the phase curves explain the disposition of the bands at 3250 Å. W. R. A.

Dependence of ultrasonic diffraction patterns of glasses on the type of prismatic form. H. Rötger (*Naturwiss.*, 1940, **28**, 644—645).—When light is passed through glass bodies which are set into elastic vibration by ultrasonic waves diffraction patterns with definite points are obtained. The position of the points depends on the form of the vibrating body and can be readily calc. for simple shapes. The cases of a cube, a prism with base angles 50° , and a prism with base angles 60 – 25° are considered. A. J. M.

Electric phenomena involved in the cavitation caused by supersonic vibrations in liquids. J. I. Frenkel (*J. Phys. Chem. Russ.*, 1940, **14**, 305—308).—The mechanism of the electric discharges in gas bubbles produced by supersonic vibrations in ionic liquids (cf. Bresler, A., 1941, I, 481) is discussed. When a "crack" is suddenly formed the concns. of an ionic species on the opposite sides of the "crack" are not identical because of the fluctuations of concn. The most probable charge on one of the walls of the "crack" is $e(n\pi^2d)^{1/2}$; e is the charge of the ions, n their no. per c.c., d the width of the "crack," and r the radius of the bubble to which the "crack" gives rise. If r exceeds the free path of electrons in the gas filling the bubble, and the pressure of the gas is low, the field due to this charge may exceed the breakdown voltage, and a discharge occurs. Under usual conditions this field may be 600 v. per cm. or more. If a bubble starts from a spherical cavity no discharge can occur. Dipoles can produce only very weak fields. J. J. B.

Thermodynamic functions for two-dimensional quantum statistics. B. N. Singh (*Indian J. Physics*, 1941, **15**, 73—78).—Mathematical. The various thermodynamical functions for a ν -dimensional space for a gaseous assembly obeying Fermi-Dirac or Bose-Einstein statistics are evaluated and the vals. of these functions for a two-dimensional space have been deduced as a special case. The results are applied in the deduction of magnetic susceptibility of a free-electron gas when the electrons are confined to a plane. W. R. A.

Van der Waals force between a proton and a hydrogen atom. C. A. Coulson (*Proc. Roy. Soc. Edin.*, 1941, **61**, 20—25).—Mathematical. The van der Waals, or polarisation, force between a proton and a H atom is expressed as a power series in r , the distance between the two particles. The coeffs. in the series can be evaluated exactly. O. D. S.

Solid states of H₂ and D₂. M. Toda (*Proc. Phys.-Math. Soc. Japan*, 1940, **III**, **22**, 503—507; *Rev. Phys. Chem., Japan*, **M 2** (A, I).

1941, **15**, 55).—Assuming each mol. in the solid to vibrate in its potential cage formed by its neighbours, the lattice spacing, heat of sublimation, and compressibility are computed in terms of intermol. forces of the Lennard-Jones type. J. W. S.

Correction for nuclear motion in H₂⁺. V. A. Johnson (*Physical Rev.*, 1941, [ii], **60**, 373—377).—Mathematical. A correction term derived by Van Vleck (cf. A., 1936, 918) is required to reduce the first-order to a second-order error in the energy of H₂⁺ computed by use of a separable approx. Hamiltonian. For the calculation of this term, which is a function of the internuclear distance R , the wave function is required. The ground-state wave function of H₂⁺ is accurately determined for $R = 1.20$ – 2.75 at. units, and wave function coeffs. with corresponding energy vals. are tabulated. Correction terms are then calc. for a set of vals. of R . Including the proper correction term, the total negative energy of H₂ for the equilibrium internuclear distance is $1.20472 \pm 0.00001 E_H = 132,132 \pm 10$ cm.⁻¹ N. M. B.

Momentum distribution in molecular systems. IV. The hydrogen molecular ion H₂⁺. W. E. Duncanson, V. M. Momentum distribution and the shape of the Compton line for CH₄, C₂H₂, C₂H₄, and C₂H₆. W. E. Duncanson and C. A. Coulson (*Proc. Camb. Phil. Soc.*, 1941, **37**, 397—405, 406—421; cf. A., 1941, I, 100).—IV. The momentum distribution of the single electron in H₂⁺ has been calc. using approximations to the wave function for the mol. other than those used by Coulson (*loc. cit.*). The function of James (A., 1935, 279), which gives accurate vals. for the binding energy of H₂⁺, gives an improved approximation to experimental results for Compton scattering.

V. The mean radial momentum distributions in the mols. CH₄, C₂H₂, C₂H₄, and C₂H₆ have been calc. and the Compton profiles deduced, assuming that each electron acts as a single scattering centre and that the mean radial distribution is the sum of the partial distributions calc. for each type of bond. The distributions for the four mols. are similar in shape but the peak val. moves towards greater vals. of mean radial momentum per electron as the saturation of the C-C bond increases. The partial distributions for the C-C and C-H bonds, the π electrons, which convert the C-C into double or triple bonds, and the 1s electrons of the C atoms are shown for C₂H₄. The importance of the contribution of the C-H bonds is emphasised. The calc. Compton profile for CH₄ shows a half-width 30% < the experimental val. of Hughes and Mann (A., 1938, I, 109). The discrepancy may be in part due to inaccuracy in the wave functions used in the calculations (cf. part IV), and in part to incorrect interpretation of the experimental results from which the Compton profile was deduced. O. D. S.

Velocities of electrons in hydrocarbon bonds. A. L. Hughes and T. Enns (*Physical Rev.*, 1941, [ii], **60**, 345—350; cf. A., 1939, I, 230).—Measurements of the distribution of energies among the electrons scattered inelastically from a beam of 8000-v. electrons by C₂H₂, C₂H₄, C₂H₆, and CH₄ give information as to the velocities of the bonding electrons, but not the K electrons of the C atoms. The distribution curves are substantially the same for C₂H₂ and C₂H₄ and for C₂H₆ and CH₄. A convenient parameter to summarise the results is the val. of the component velocity at "half max.," which is closely analogous to the half-width of a spectrum line. The component electron velocities at half max. are, respectively, 29.7, 29.7, 26.7, and 26.7 ($\times 10^7$ cm. per sec.). The bearing of results on the types of bonds in the mols. is briefly discussed. N. M. B.

Magnetic studies of co-ordination compounds. III. Factors affecting the nature of bonds between nickel and certain non-metallic atoms. IV. Square co-ordinated cobaltous compounds. D. P. Mellor and D. P. Craig (*J. Proc. Roy. Soc. N.S.Wales*, 1940, **74**, 475—494, 495—501).—III. The mol. susceptibilities (χ) and the magnetic moment (μ) of the Ni atom are recorded for 37 org. Ni complexes. The characters of the Ni-O, Ni-S, and Ni-N bonds are determined not only by the electro-negativity of the attached atoms but also by structural and steric effects.

IV. Data for χ and μ of the Co atom for 21 org. Co complexes show that most of the org. compounds which produce square complexes with Ni do so with Co also. Such complexes are very stable towards H₂O. As in the case of Ni there is rough correlation between colour and magnetic

properties, covalent complexes being brown whilst ionic complexes vary from pink and mauve to blue. C. R. H.

Statistics of the two-dimensional ferromagnet. I, II. H. A. Kramers and G. H. Wannier (*Physical Rev.*, 1941, [ii], 60, 252–262, 263–276).—I. Mathematical. In an effort to make statistical methods available for the treatment of co-operational phenomena, the Ising model of ferromagnetism is treated by rigorous Boltzmann statistics. The task of finding the state sum is reduced to finding the largest eigenvalue of some finite matrix. The matrices of the sequence derived possess a symmetry property which permits location of the Curie temp. It lies at $J/kT_c = 0.8814$, where J denotes the coupling energy between neighbouring spins.

II. The sp. heat of the Ising model at the Curie temp. is computed for six successive finite matrix problems. Results indicate that the sp. heat is infinite at the Curie point. A new closed form approximation of the partition function λ is developed by using the matrix method in its variational form, and is much superior to the older procedures.

N. M. B.

Colour and bond character. K. S. Pitzer and J. H. Hildebrand (*J. Amer. Chem. Soc.*, 1941, 63, 2472–2475).—From an examination of m.p., colour in the molten state, colour in CS_2 or MeOH, heat of formation per bond, and complex ion formation tendency of I_2 , SbI_3 , SnI_2 , SnI_4 , AgI , InI_3 , and CdI_2 it is concluded that when the colour of a compound deviates from that of its constituent ions a deviation from pure ionic bond character is to be anticipated (cf. A., 1918, ii, 142). The conclusion is in accord with the excited electronic state responsible for light absorption and with the Franck-Condon principle.

W. R. A.

Micellar structure of cellulose and its derivatives. O. Kratky (*Angew. Chem.*, 1940, 53, 153–162).—A review of the structure and dimensions of, and effect of dissolution and reprecip. on, cellulose and its derivatives, in the light of the "fringed-micelle" theory.

A. Lr.

Critical and co-operative phenomena. VI. The neighbour distribution function in monatomic liquids and dense gases. J. Corner and J. E. Lennard-Jones (*Proc. Roy. Soc.*, 1941, A, 178, 401–414).—The distribution function is deduced assuming that each atom vibrates in the field of its neighbours when in their equilibrium positions; correlation between the motion of neighbouring atoms is neglected. A parabolic potential leads to simple results; when applied to K a structure is obtained resembling the body-centred cube. The interat. field can be derived from the distribution function when this has been determined experimentally.

G. D. P.

Parachors of bonds. I. G. N. Copley (*Chem. and Ind.*, 1941, 702–705).—The parachor of an ionic, metallic, or single covalent linking is given by $[P] = A\{r^{2.5} - (U_0)^{0.25} - B\}$, where U_0 is the linking energy, r is the interat. distance, and A and B are consts. which depend on the type of crystal lattice for the compound considered. Data supporting this relation are given for alkali metal, Tl , Cu , and Ag halides, $CaCl_2$, $BaCl_2$, $SnCl_2$, and $PbCl_2$. Simple theory gives a similar expression without B , which may arise from inaccurate $[P]$ vals. Log $[P]$ shows an approx. linear relation to log r .

A. J. E. W.

III.—CRYSTAL STRUCTURE.

Two types of X-ray reflexion in crystals. (Sir) C. V. Raman and N. S. N. Nath (*Proc. Indian Acad. Sci.*, 1940, 12, A, 427–439).—The theory of the so-called modified or quantum X-ray reflexions in crystals is considered. These reflexions are due to inelastic collisions in which the photon excites the vibration of the lattice, and is itself reflected by the dynamic stratifications of electron density arising from these vibrations. The modified reflexions obey the Bragg principle with respect to the dynamic spacings, but these usually differ from the static spacings and are differently oriented. The intensity of the modified reflexions is considered. It is very different in the two cases where $h\nu \gg kT$ and $h\nu \ll kT$ (ν is optical frequency of the lattice vibration). The increase of intensity of the modified reflexions with rise of temp. is accompanied by a decrease in the intensity of the unmodified reflexions from the same spacings.

A. J. M.

Geometry of the quantum reflexion of X-rays in diamond. P. R. Pisharoty (*Proc. Indian Acad. Sci.*, 1941, 14, A, 56–69).

—Mathematical. The geometrical aspects of the Raman reflexions from the (111) planes of diamond based on the Raman-Nath formula are discussed.

W. R. A.

Interference double refraction of X-rays in crystal prisms. M. von Laue (*Naturwiss.*, 1940, 28, 645–646).—The production of double refraction with interference is discussed.

A. J. M.

Crystal projection. V. Rosický (*Z. Krist.*, 1940, 103, 71–72).—A construction is described for graphical determination of the zone which passes through a given point and intersects a specified zone at a given angle.

A. J. E. W.

Structure of cobalt. O. S. Edwards, H. Lipson, and A. J. C. Wilson (*Nature*, 1941, 148, 165).—An explanation of the variation of sharpness in the lines of the powder photographs of hexagonal Co is advanced.

L. S. T.

Crystal structure of silicon monoxide. H. Inuzuka (*Mazda Kenkyu Jiho*, 1940, 15, 305–309; *Rev. Phys. Chem. Japan*, 1941, 15, 56).—SiO has space-group T_h^6 with a_0 6.4 Å. The cubic unit cell contains 8 mols. The structure indicates that the Si atom is at the centre of a sheared tetrahedron of 4 O atoms.

J. W. S.

Analysis of calcined lime by X-rays. K. Akiyama (*Waseda Appl. Chem. Soc. Bull.*, 1940, 17, 26–27; *Rev. Phys. Chem. Japan*, 1941, 15, 56–57).—The X-ray diffraction pattern of $CaCO_3$ calcined at 900° is the same as for that calcined at higher temp. This indicates that crystallisation occurs partly at 900° and that differences in reactivity are due to the coarseness of the state of aggregation.

J. W. S.

X-Ray investigation of some niobium compounds. J. Umanski (*J. Phys. Chem. Russ.*, 1940, 14, 332–339).—A sample of Nb containing 0.42% of H gave patterns corresponding with two isometric space-centred lattices with spacings 3.300–3.306 Å. and 3.416–3.420 Å., the first belonging to Nb and the second presumably to NbH (not yet known). The hydride spacings disappear after heating in vac. at 800°. Nb nitride (8.8% of N) has a hexagonal lattice, $a = 3.017$, $c = 5.580$ Å. Nb carbides form face-centred cubes; the spacing increases from 4.395 Å. for 2.5% of C to 4.462 Å. for 10.9% of C, but the increase is irregular, suggesting the presence of two carbides (Nb_4C or Nb_2C , and NbC or Nb_3C_2). The results of Becker and Ebert (*Z. Physik*, 1925, 31, 268) are disproved.

J. J. B.

Significance of X-ray diffraction patterns obtained from starch granules. R. S. Bear and D. French (*J. Amer. Chem. Soc.*, 1941, 63, 2298–2305).—X-Ray diffraction patterns of moist corn (I), waxy maize, banana, and potato (II) starch at room temp. and of recryst. sol. starch (III) at room temp., 40°, 50°, 60°, and 70° have been obtained using a well-collimated beam of monochromatic X-radiation. Two extreme patterns, A from (I) and (III) at 50°, 60°, and 70°, and B from (II) and (III) at room temp. and 40°, are differentiated. It is considered that the diffractions are of a single major component of the starch granules and that ring-forming correspondence exists between A and B. From analysis of B, vals. of α , β , γ , and θ are determined and applied successfully to A with slight changes. The no. of maltose residues per unit cell is two. Starch granule crystallites are considered as built on triclinic lattices, the axes of which are approx. orthogonal. The space-group is C_2^1 . The validity of the unit cells chosen and the relation of the observed results to straight, branched, and spiral chain models for starch are briefly discussed.

W. R. A.

Crystal chemistry of hetero-poly-acids. Is there an "isomeric borotungstic acid"? O. Kraus and F. Muschnug (*Naturwiss.*, 1940, 28, 238–239).—Hydrates of borotungstic acid $H_5[B(W_3O_{10})_4]$ with $5H_2O$ (cubic), $14H_2O$ (triclinic), and $30H_2O$ (tetragonal) exist, together with an acid forming very small hexagonal crystals designated as an acid isomeric with the $30H_2O$ compound. The existence of isomerism has not, however, been confirmed with X-ray powder diagrams. Owing to the uncertainty of the Debye process when applied to hygroscopic substances where intermediate hydrates may exist, the acid has been investigated by the rotating-crystal method. The formulae $B_2O_3.28WO_3.62H_2O$ (I) and $B_2O_3.24WO_3.53H_2O$ (II) (or $H_5[B(W_3O_{10})_4].24H_2O$) have been proposed for the compound from analytical investigation. The rotating-crystal method gives a 21.66, c 21.54 Å. From the d (4.36) it follows that the no. of mols. in the unit cell is 12 if the formula is (I), and 14 if it is (II). There are three

possible space-groups, which, however, only allow for 4, 8, 12, or 24 mols. in the unit cell. Hence formula (II) is impossible, and there is no "isomeric" borotungstic acid.

A. J. M.

Crystal structure of potassium sulphamate. J. A. A. Ketelaar and E. L. Heilmann (*Z. Krist.*, 1940, 103, 41—53).—From rotation and oscillation X-ray diagrams, the unit cell of $\text{NH}_2\text{SO}_3\text{K}$, containing 4 mols., has a 8.26, b 8.29, c 5.90 Å. (all ± 0.01 Å.), $a:b:c = 0.996:1.0712; \rho_{\text{obs.}} 2.19; \rho_{\text{calc.}} 2.21$; space-group D_{2h}^{21} (*Pbma*). The structure is determined by Patterson and Fourier analyses on (010), and parameters and interdistances are given for K, S, N, and O; the position of the H atoms is discussed. NH_2SO_3 forms a slightly distorted tetrahedron similar in size to SO_4 . The structure probably contains H linkings.

A. J. E. W.

Crystal structure of *dl*-alanine. H. A. Levy and R. B. Corey (*J. Amer. Chem. Soc.*, 1941, 63, 2095—2108).—From X-ray data using $\text{Cu K}\alpha$ radiation *dl*-alanine crystals have an orthorhombic unit with a_0 12.04, b_0 6.04, c_0 5.81 Å., 4 mols. of $\text{NH}_2\text{CHMeCO}_2\text{H}$ (I) per unit cell, space-group C_{2h}^2 —*Pna*. The following interat. distances are given: C—O 1.25 and 1.23, C—C 1.54, C—N 1.42 Å. Mols. of (I) are linked together by a three-dimensional framework of H bonds with a separation of 3.64 Å. between Me of adjacent mols. Special features of the structure are discussed and their implications in the study of protein structure are indicated.

W. R. A.

Determination of the inner potential by an electron reflexion method. T. Yamaguchi (*Proc. Phys.-Math. Soc. Japan*, 1939, III, 21, 375—388; *Rev. Phys. Chem. Japan*, 1941, 15, 57).—Two plane-parallel ZnS blocks of equal thickness, one with etched and the other with clean cleaved faces, are arranged close together with their crystallographic axes nearly parallel. Two sharp and nearly parallel electron beams impinging at grazing incidence on the two faces are selected by a slit system and reflected on to a photographic plate. This permits investigation of the mode of increase of reflective index under conditions in which the ratio of λ and spacing for each order reflexion is known precisely.

J. W. S.

Diffraction of waves from a curved lattice. V. A. Fock and V. A. Kolpinski (*J. Physics U.R.S.S.*, 1940, 3, 125—140).—Diffraction intensity is calc. for a cylindrical lattice and applied to the diffraction of fast electrons by bent mica. The results agree with experimental patterns obtained with curved, extremely thin mica films.

L. J. J.

Electron diffraction intensities. K. Lark-Horovitz and H. J. Yearian (*Nature*, 1941, 148, 287—288; cf. A., 1941, I, 104).—Difference in shape of crystals or difference in absorption in different directions does not account fully for the intensity anomalies observed in the diffraction pattern of ZnO . Other effects such as distortion of the electron cloud and dynamic effects of reflexion must be taken into account.

L. S. T.

Fresnel electron diffraction. H. Boersch (*Naturwiss.*, 1940, 28, 709—711).—Diffraction phenomena with electrons corresponding with Fresnel diffraction in optics have been observed in electron microscopy. Direct measurement of the distance of the source of electrons from the object and the distance apart of the interference max. makes it possible to obtain the λ of the electrons.

A. J. M.

Fresnel diffraction phenomena in the electron microscope. H. Boersch (*Naturwiss.*, 1940, 28, 711—712).—The conditions under which Fresnel diffraction appears in electron microscopy are outlined. The occurrence of these diffraction patterns may give rise to false images. The extent of Fresnel diffraction patterns is usually very small. With an illumination aperture of 10^{-2} and λ 5×10^{-10} cm. the distance of the diffraction max. from the edge of the image is below the resolving power of the microscope. Signs of Fresnel diffraction can, however, be observed without the occurrence of a definite max.

A. J. M.

Electron diffraction study of the mechanism of crystallisation of salts from their aqueous solutions; zinc chloride. S. Yamaguchi (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, 38, 382—386; cf. A., 1941, I, 82).—The electron diffraction patterns of the amorphous substance existing just before ZnCl_2 crystallises from aq. solution show spacings characteristic of the (111), (100), (210), and (210) lattice planes of the ZnCl_2 crystal. The mechanism of crystallisation is discussed.

O. D. S.

Diffraction of fast electrons in thin films of hydratocellulose. V. A. Kargin and D. I. Leipunskaja (*J. Phys. Chem. Russ.*, 1940, 14, 312—319).—Denitrated cellulose nitrate gives with fast electrons (30—40 kv.) spacings 4.45—4.73, 1.88—2.01, and 1.08—1.27 Å.; they are not affected by boiling H_2O or by freezing. These spacings, and the width of the diffuse circles on the electron diffraction patterns, agree almost quantitatively with those calc. for cellobiose. Hydratocellulose contains no cryst. micelles, and a differentiation between processes within, and those between, micelles is void.

J. J. B.

Structural investigation of the Mills-Nixon effect. Electron diffraction and structure of 1:3:5-tribromobenzene, *o*-dibromo-xylene, -hydrindene, and -tetralin. A. Kossiakoff and H. D. Springall (*J. Amer. Chem. Soc.*, 1941, 63, 2223—2230).—The structures of 1:3:5- $\text{C}_6\text{H}_3\text{Br}_3$, and *o*-dibromo-xylene, -hydrindene, and -tetralin have been determined by electron diffraction methods. The C—Br distance in 1:3:5- $\text{C}_6\text{H}_3\text{Br}_3$ is 1.84 ± 0.02 Å. In the Br_2 -compounds C—Br is 1.86 ± 0.02 Å. and the angle C—C—Br is $122 \pm 2^\circ$. The results have been correlated with dipole moment data by considering the excited ionic structures of the Br_2 -compounds. The Mills-Nixon effect is more concerned with changes in the contributions of excited states of the mol. than with freezing double bonds in the ring into a particular Kekulé structure.

W. R. A.

Equilibrium form of the fluorite crystal. G. Bradistilov and I. N. Stranski (*Z. Krist.*, 1940, 103, 1—29).—Theoretical. The equilibrium form is determined by Stranski and Kaischev's method (cf. A., 1935, 1059), using Bradistilov's data for electrostatic potentials in the lattice (cf. A., 1941, I, 328).

A. J. E. W.

Electrostatics of the crystal lattice. M. von Laue (*Z. Krist.*, 1940, 103, 54—70).—The determination of the mean potential (Φ) of a crystal lattice is discussed theoretically. In general, Φ in an infinite lattice varies with position. The theory is not applicable to actual crystals, in which Φ is largely determined by the boundary conditions.

A. J. E. W.

Dielectric strength of mixed crystals. H. Fröhlich (*Proc. Roy. Soc.*, 1941, A, 178, 493—498).—The increase in the breakdown strength of ionic crystals due to the presence of foreign atoms is calc. Good agreement with experiment is obtained. It is shown that, if $I_p^2(T)$ is the dielectric strength of the pure crystal and $F(T)$ that of the crystal with foreign atoms, $F^2(T) - I_p^2(T)$ should be independent of temp.

G. D. P.

Electrical breakdown of insulating crystals. A. A. Vorobiev (*J. Physics U.R.S.S.*, 1940, 3, 73—80).—The breakdown voltage of crystals of the alkali halides is correlated with the ionisation energy of the most loosely bound electrons, the lattice energy, the activation energy and m.p., and the polarisability of the crystal lattice. It is concluded that the electrical stability of solid dielectrics is a physical property determined by the chemical composition and crystal structure, and not dependent on slight structural irregularities.

L. J. J.

New magneto-caloric effect. N. S. Akulov and L. J. V. Kirenski (*J. Physics U.R.S.S.*, 1940, 3, 31—34).—It is shown theoretically that if a ferromagnetic single crystal is rotated in a strong magnetic field at low temp. it must become periodically heated and cooled, corresponding with the rotation. This was confirmed experimentally with a single crystal of Ni, which was placed so that the (110) plane was in the direction of the field. The temp. change was detected by a Bi-Sb/Cu thermo-element, and the observations were made at -190° . There is qual. and quant. agreement with theory. The effect is not observed with polycryst. materials, and rapidly decreases with rise of temp., in contrast to the Weiss effect.

A. J. M.

Temperature-dependence of the magnetic anisotropy of cobalt single crystals. S. V. Vonsovski (*J. Physics U.R.S.S.*, 1940, 3, 83—93).—The temp.-dependence of the magnetic anisotropy of Co single crystals is calc. on the basis of Bloch and Gentile's model (cf. A., 1931, 1003). The calc. data are in qual. agreement with experiment, and show a change of sign for the anisotropy const. at $\sim 500^\circ$ K. The effect of direction of magnetisation on sp. heat of Co single crystals is estimated.

L. J. J.

Absolute saturation magnetisation of nickel-antimony and nickel-tantalum alloys. G. T. Rado and A. R. Kaufmann

(*Physical Rev.*, 1941, [ii], 60, 336—339).—Measurements of abs. saturation magnetic moment per atom M as a function of at. composition τ at fields up to 40,000 gauss and temp. down to 77.2° K. gave an initial slope $dM/d\tau$ of -3.6 and -5.7 Bohr magnetons per substituted atom for Ni-Sb and Ni-Ta, respectively. The disagreement of the former val. and the data of Sadron (cf. A., 1932, 679) and Marian (cf. A., 1937, I, 297) is discussed in conjunction with "superposed paramagnetism." Available data on ferromagnetic binary alloys show the present results to be additional exceptions to the wide range of applicability of the energy band theory (cf. Slater, A., 1936, 1055). The "anomalous" behaviour of Fe alloys is briefly discussed. N. M. B.

Volume magnetostriction of nickel. R. Smoluchowski (*Physical Rev.*, 1941, [ii], 60, 249—251).—A theory previously developed and applied to Fe (cf. A., 1941, I, 194) is applied to Ni, and data on Fe are corr. The mol. field factor, its dependence on vol., and the magnetisation at abs. zero and its dependence on vol. are calc. and discussed. N. M. B.

Light figures in single crystals of nickel and copper. M. Yamamoto (*Nippon Kinzoku Gakkai-Si*, 1940, 4, 368—376; *Rev. Phys. Chem. Japan*, 1941, 15, 57).—The technique of preparing single crystals of Ni and Cu by slow solidification and of producing and observing light figures on crystals has been developed. Single Ni and Cu crystals were etched in acid or salt solutions and light figures on the three principal crystal planes observed at intervals. The symmetry characteristics of the light figures are invariable but their forms generally vary with the etching agent, temp., and time of etching. The most suitable light figures for determination of crystal orientation are generally those on (100) planes. J. W. S.

Effect of lattice strain on reflectivity of silver. Y. Kidani (*Mem. Ryojun Coll. Eng.*, 1941, 14, 15—30).—The effect of various strains on the position of the min. of reflectivity of Ag has been determined. Tensile strain, annealing, and etching displaced the min. to the long- λ side, and compression and polishing had the reverse effect. Plastic deformation produced no effect. The effect on Ag films deposited on base metals was also investigated. The min. was displaced to shorter λ for Ag on Cu, because of the compression caused by the smaller Cu lattice (compared with that of Ag). The effect of strain on the min. was deduced on the basis of statistical mechanics. The annealing of a film of Ag sputtered on quartz was investigated. The film was usually amorphous at first, but became cryst. on annealing above 450°. A. J. M.

Turning of crystal lattice under plastic strain. V. I. Startzev (*J. Physics U.R.S.S.*, 1940, 3, 107—110).—Rock-salt crystals deformed by compressive stresses at temp. between 400° and liquid N_2 temp. have been examined by optical and X-ray methods. The crystal breaks up into a no. of blocks which increases linearly with the load. The blocks rotate through an angle which increases with the load and varies with temp. in the order $400^\circ > 200^\circ > -196^\circ > 20^\circ$. The temp. effect is qualitatively similar to that found in the case of the strengthening curves. Plastic deformation of rock-salt is concluded to involve a shifting of atoms along the (110) direction in the rhombic dodecahedron plane, analogous to twinning. L. J. J.

Effect of stress on internal friction in polycrystalline copper. A. W. Lawson (*Physical Rev.*, 1941, [ii], 60, 330—335; cf. Read, A., 1940, I, 405).—For O-free specimens under increasing compressive stress, the internal friction increases and then decreases. As the internal friction increases 100%, Young's modulus decreases ~6% for a stress of 90 kg. per sq. cm. An increase of stress to 160 kg. per sq. cm. leaves a remnant increase of only 40% in the internal friction and a remnant decrease of 4% in Young's modulus. The effect is nearly independent of temp., and no explanation of this is available, although the Taylor dislocation of plasticity gives a qual. explanation of data at any one temp. N. M. B.

IV.—PHYSICAL PROPERTIES OF PURE SUBSTANCES.

Kinetics of phase transformations of steel. N. S. Akulov and N. I. Strutinski (*J. Physics U.R.S.S.*, 1940, 3, 35—41).—An apparatus for the investigation and photographic recording of rapid phase transformations in ferromagnetic metals is described. The sample of steel, in the form of an ellipsoid

of revolution, is attached to a quartz or porcelain tube, making an angle with a strong magnetic field. The other end of the tube is attached to a very sensitive tensometer. Change in the saturation which occurs at a phase transformation causes a moment which is registered on the tensometer. The isothermal breakdown of austenite in steel containing 0.95% C was investigated over the range 500° to -196° . A. J. M.

Magnetic susceptibility of cadmium amalgams. H. S. V. Ramiah (*J. Mysore Univ.*, 1941, 1, 155—157).—The susceptibility of Cd-Hg has been determined for amalgams containing up to 6% Cd by wt. The vals. calc. for the susceptibility from the mixture law are < the observed vals., showing that the diamagnetic susceptibility of Hg is lowered by the addition of small amounts of Cd. This is explained by a change in the no. of free electrons brought about by the process of dissolution. A. J. M.

Dislocation theory of plastic deformation. J. S. Koehler (*Physical Rev.*, 1941, [ii], 60, 397—410).—Mathematical. The lattice imperfections assumed to account for plastic deformation are studied in detail. The strain energy associated with these dislocations is calc. for a dislocation in a uniform shear stress, two dislocations in an infinite medium, and a dislocation near a surface. A force tending to attract dislocations towards the surface is found. About twice as much energy is required to produce a certain amount of slip inside as at the surface. The energy required to produce a dislocation is several e.v. per at. plane, depending on how produced and its location. Energy stored during work-hardening calc. by assuming that the dislocations are arranged in a regular two-dimensional lattice in the material agrees with experimental vals. The density of dislocations for severely work-hardened material agrees with available predictions. N. M. B.

Paramagnetic dispersion measurements at 77.3° K. C. Starr (*Physical Rev.*, 1941, [ii], 60, 241—249).—The dispersion of the magnetic susceptibility of some paramagnetic compounds of Fe, Mn, and Cr is studied over a frequency range 2—10 Mcycles per sec. with magnetic fields up to 60,000 gauss. Results support the theory of Casimir and du Pre (cf. A., 1938, I, 391) based on the thermal coupling between the magnetic spin system and the lattice vibrations. The magnitude of the cryst. field splitting of the energy levels of the ground state is determined from the experimental results, for an assumed type of cryst. field and ionic arrangement. The splitting of Cr NH_4 alum differed from that of Cr K alum. The relaxation time for Fe NH_4 alum, studied as a function of the magnetic field, fits an empirical formula based on the theoretical conclusions of Van Vleck (cf. A., 1940, I, 200). N. M. B.

Magnetic measurements on tin trimethyl and lead tricyclohexyl. H. Morris and P. W. Selwood (*J. Amer. Chem. Soc.*, 1941, 63, 2509—2510).—The magnetic susceptibilities of $SnMe_4$ (0.0041 and 0.047m.) and of Pb tricyclohexyl (I) (0.011m.) in C_6H_6 have been measured at 40° and 90° with a Gouy balance. Neither $SnMe_4$ nor (I) is appreciably dissociated to the monomeride, in disagreement with recorded mol. wt. results. It is suggested that the large size of Sn and Pb atoms diminishes the stability of organo-metallic free radicals as compared with C-free radicals. W. R. A.

Solid carbon dioxide as an exciter of vibrations. M. D. Waller (*Nature*, 1941, 148, 185—187).—The production and maintenance of pure loud tones by contact between solid CO_2 and metal objects are described. The range of frequencies most easily excited lies between 1000 and 4000 cm. per sec., and depends but little on the size, shape, mass, or material of the vibrating object. Production of Chladni figures on plates is illustrated. L. S. T.

Ultrasonic velocities in solutions. L. Sibaiya and R. L. Narasimhaiya (*J. Mysore Univ.*, 1941, 1, 133—140).—The variation of ultrasonic velocity, and hence of the compressibility, with concn. in solutions of $C_{10}H_8$ in polar and non-polar solvents (PhMe, C_6H_6 , $CHCl_3$, CCl_4) has been investigated. The free vol. of $C_{10}H_8$ is also obtained. The velocity of supersonic waves in solid $C_{10}H_8$, obtained by extrapolation of the velocity-concn. curves for the solutions, is 1554 m. per sec. at 20°, in agreement with Schaafs (A., 1937, I, 404). This val., however, refers to the solute in a hypothetical liquid state, having only bulk modulus and no

rigidity, resembling a condensed gaseous state, and not to the solid in bulk.

A. J. M.

Specific heat of super-conductive tantalum. K. Mendelssohn (*Nature*, 1941, 148, 316—317).—The sp. heat-temp. curve (reproduced) shows a break at 4.4° K., the temp. at which electrical resistance disappears, and the magnetic transition point. The discontinuity, $\sim 9 \times 10^{-3}$ g.-cal. per mol., is sharp, and the drop in sp. heat occupies $\frac{1}{2}$ a few hundredths of one degree (cf. A., 1939, I, 602). Pure Ta thus behaves similarly to other pure superconductors.

L. S. T.

Thermodynamic functions of acetone. I. Godnev, A. Pajuchina, and A. Sverdlin (*J. Phys. Chem. Russ.*, 1940, 14, 374—379).—Using the method of Pitzer (A., 1937, I, 398, 557) and the most probable model of the COMe₂ mol. the entropy, free energy, and heat capacity of COMe₂ between 298° and 1500° K. are calc. The calc. sp. heat agrees with the observed val.

J. J. B.

Heat capacities and entropies of three disaccharides. A. G. Anderson and G. Stegeman (*J. Amer. Chem. Soc.*, 1941, 63, 2119—2121).—Vals. of C_p from 60° to 298° K. have been determined calorimetrically for α -lactose monohydrate, β -lactose, and β -maltose monohydrate and, from these, vals. of entropy and free energy of formation of each have been calc.

W. R. A.

Heat capacities and entropies of two monosaccharides. G. W. Jack and G. Stegeman (*J. Amer. Chem. Soc.*, 1941, 63, 2121—2123).—Vals. of C_p from 60° to 298° K. have been determined calorimetrically for α -D-galactose and L-sorbose and, from these, vals. of entropy and free energy of formation of each have been calc. L-sorbose exhibits a transition of the type displayed by NH₄Cl at $\sim 200^\circ$ K.

W. R. A.

Heat capacity of glucose glass. E. W. Nelson and R. F. Newton (*J. Amer. Chem. Soc.*, 1941, 63, 2178—2182).—Constructional and operational features of a calorimeter which works at 60° are given. Equilibrium C_p vals. for glucose glass from 5° to 60° and for CHCl(CH₂Cl)₂ from 0° to 60° have been measured. The changes in heat content have been measured on dry glucose glass and in samples containing $\frac{1}{2}$ 3% of H₂O. 1% of H₂O depresses the congealing temp. $\sim 8^\circ$ and the equilibrium heat content was not attained even after 3 weeks.

W. R. A.

Heat capacity and entropy, heats of fusion and vaporisation, and vapour pressure of dimethyl ether. Density of gaseous dimethyl ether. R. M. Kennedy, M. Sagenkahn, and J. G. Aston (*J. Amer. Chem. Soc.*, 1941, 63, 2267—2272).—The following vals. are given: m.p. 131.66 \pm 0.05° K.; b.p. 248.34 \pm 0.05° K.; v.p. (from 170° to 190° K.) $\log p_{\text{mm.}} = (4245 - 203/T) + 120.4931 \log T - 0.1225960T - 272.249320$, (from 190° to 249° K.) $\log p_{\text{mm.}} = (-1691.806/T) - 6.045600 \times \log T + 0.001957540T + 23.6861850$; heat of fusion 1179.8 \pm 0.9 g.-cal. per mol.; heat of vaporisation 5141 \pm 5 g.-cal. per mol.; second virial coeff. -0.4461 ± 0.0015 l. per mol. at 298° K. Vals. of C_p from 13.2° to 248.3° K. have been determined; the derived entropy vals. differ from those obtained from mol. data and, for agreement, it must be assumed that there are three equal potential energy max. of 3100 \pm 150 g.-cal., probably due to repulsive forces, hindering the internal rotation of Me groups. The vals. of $S_{298.16^\circ \text{K.}}$ for ideal gas and superheated liquid are 63.72 \pm 0.20 and 44.98 \pm 0.40 g.-cal. per degree per mol., respectively.

W. R. A.

Heat capacity and entropy, heats of fusion and vaporisation, and the vapour pressure of silicon tetramethyl. J. G. Aston, R. M. Kennedy, and G. H. Messerly (*J. Amer. Chem. Soc.*, 1941, 63, 2343—2348).—SiMe₄ has two cryst. forms. The stable (β) form has m.p. 174.12 \pm 0.05° K., and the other (α), unstable with respect to the β -form, has m.p. 171.04 \pm 0.05° K. The equilibrium for the transition between α - and β -forms is $>$ the m.p. and has been calc. as 199.2 \pm 1.0° K. The normal b.p. is 299.80 \pm 0.05° K. V.p. measurements from 208° to 293° K. can be represented by $\log p(\text{mm.}) = -2346.9849/T - 12.239609 \log T + 0.00662430T - 39.038565$. With MeI SiMe₄ forms a min.-boiling mixture, b.p. 26.1 \pm 0.1° (1 atm.). The eutectic point for the system SiMe₄-MeI is at 171.78 \pm 0.05° K. and presumably involves β -SiMe₄. C_p vals. for α - and β -forms of solid SiMe₄ and for the liquid have been determined from 11.5° to 295.7° K. Heats of fusion are: α -form 1426.8 \pm 0.7, β -form 1648.0 \pm 3.5 g.-cal. per mol. The heat of vaporisation at the b.p. is 5785 \pm 16.0 g.-cal. per mol. and the second virial coeff. is

$-1.208 + 0.01$ l. per mol. at 296.9° K. The molal entropy of the ideal gas, calc. from the calorimetric data is 86.04 \pm 0.15 at the b.p. and 1 atm., and 77.78 \pm 0.10 g.-cal. per degree per mol. at 227° K. and 1 atm. The entropies of ideal gas and liquid at 298.16° K. are 85.79 \pm 0.15 and 66.27 \pm 0.15 g.-cal. per degree per mol. respectively. The entropy vals. derived from thermometric data are $<$ those derived from spectroscopic data and the difference is attributed to the existence of three equal potential energy max. of 1300 \pm 200 g.-cal. hindering rotation and probably due to repulsive forces.

W. R. A.

Thermodynamic properties of the crystalline forms of silica. M. A. Mosesman and K. S. Pitzer (*J. Amer. Chem. Soc.*, 1941, 63, 2348—2356).—The molal heat contents of cristobalite (I), tridymite (II), and quartz (III) have been measured at various temp. between 25° and 350°. The difference in heat content between (II) and (III) between 275° and 545° is approx. const. and, therefore, both have equal C_p vals. The following vals. for (I), (II), and (III), respectively, are given: ($H_{298}^\circ - H^\circ$) 1671, 1693, 1657; ($G_{298.1}^\circ - H^\circ$) -1367 , -1324 g.-cal. per mol; $S_{298.1}^\circ$ 10.19 \pm 0.1, -10.00 ± 0.1 g.-cal. per degree per mol. Energy differences between the modifications, heat of fusion, heats of transition, relative stabilities of the various modifications of each form, heat capacities, and standard free energies of formation are discussed. (I) is more stable than (II) at $> 1743^\circ$ K. and at $< 450^\circ$ K.

W. R. A.

Heat capacity of gaseous paraffin hydrocarbons, including experimental values for n -pentane and $\beta\beta$ -dimethylbutane. K. S. Pitzer (*J. Amer. Chem. Soc.*, 1941, 63, 2413—2418).—A new flow calorimeter is described and used to yield C_p vals. for CCl₄, n -C₅H₁₂, and CMe₃Et at temp. between their b.p. and 450°. Heats of vaporisation are, respectively, 7170 \pm 20, 6160 \pm 20, and 6355 \pm 20 g.-cal. per mol. All available data for gaseous paraffins (normal and branched) above C₂H₆ fit the equation $C_p = 5.65n - 0.62 + \theta(0.0111n + 0.0158)$, where n is the no. of C atoms. The magnitude of the potential barrier to internal rotation in n -C₅H₁₂ is discussed and is shown to be ~ 3600 g.-cal. per mol.

W. R. A.

Thermodynamics of branched-chain paraffins. Heat capacity, heat of fusion and vaporisation, and entropy of $\beta\gamma\delta$ -trimethylpentane. K. S. Pitzer and D. W. Scott (*J. Amer. Chem. Soc.*, 1941, 63, 2419—2422).—CHMePr₃ has m.p. 163.63 \pm 0.1° K. Vals. of C_p have been determined for the solid and liquid states from 14.68° to 323.59° K. The heat of fusion (2215 \pm 5 g.-cal. per mol.), heat of vaporisation (7810 \pm 30 g.-cal. per mol.), and entropy (liquid at 298.1° K., 78.71 \pm 0.2; real gas at b.p., 115.78 \pm 0.3 g.-cal. per degree per mol.) are given. The val. of S deduced from experimental data agrees with the calc. val. A simple semi-empirical formula is suggested for calculating S vals. for heavier branched-chain paraffins. This formula yields vals. in good agreement with available vals. from experiment and from statistical treatment.

W. R. A.

Densities and surface tensions of *cis*- and *trans*-decahydronaphthalene between -30° and 180° . W. F. Seyer and C. H. Davenport (*J. Amer. Chem. Soc.*, 1941, 63, 2425—2427).—The vals. of ρ and γ from -30° to 180° are recorded. ρ vals. vary linearly with θ but γ - θ curves deviate slightly from linearity.

W. R. A.

P - V - T relations for saturated liquids. H. P. Meissner and O. H. Paddison, jun. (*Ind. Eng. Chem.*, 1941, 33, 1189—1191).—Charts are given which permit the prediction of the density of a liquid from crit. temp. and pressure and v.p. data.

J. W. S.

Vapour pressure of solid phenol. M. Baranaev and V. K. Schurupova (*J. Phys. Chem. Russ.*, 1940, 14, 405).—The v.p. rises from 0.053 mm. Hg at 0° to 0.63 at 30.3°.

J. J. B.

Measurement of small vapour pressures. I. Vapour pressure of naphthalene, camphor, and glycerol. II. Vapour pressure of *cis*- and *trans*-isomerides. A. A. Zilberman-Granovskaja. III. Vapour pressure of halogen-substituted benzenes. A. A. Zilberman-Granovskaja and E. A. Schugam (*J. Phys. Chem. Russ.*, 1940, 14, 759—767, 768—773, 1004—1006).—I. The effusion method of Knudsen was used. The hole through which the vapour escapes into a vac. (10^{-6} mm. Hg) must be $<$ some max. val. depending on the v.p.; for C₁₀H₈ this was 2×10^{-3} sq. cm. The v.p. (in mm. Hg) of Hg at 0°, 18.5°, 28.9°, and 47.2° is 0.000217, 0.001083, 0.002957, and 0.008820; of C₁₀H₈ at 15.1°, 24.0°, and 32.5°

is 0.031, 0.0717, and 0.1481; of camphor (Japanese) at 0°, 16.5°, 20.3°, and 24.7° is 0.05867, 0.30477, 0.36240, and 0.54624; and of glycerol at 15.1°, 28.9°, 47.0°, and 80.1° is 0.00181, 0.00310, 0.00429, and 0.00872. The experimental error was 0.3%. Glycerol was purified by repeated distillation in vac. until its v.p. became const.; this const. val. is < earlier data by Gerlach and Stedman. $C_{10}H_8$ was purified by heating at 130° and sublimation.

II. The v.p. at 23.2°, 32.7°, and 47.0° of *cis*-decahydronaphthalene is 0.01707, 0.03977, and 0.15610, of the *trans*-form 0.01932, 0.04889, and 0.19052, of the *cis*- β -allyl derivative 0.003299, 0.009397, and 0.049256, and of the *trans*-form 0.003696, 0.01170, and 0.05873. The v.p. of *cis*-*cis*-dicyclohexyl at 0°, 23.25°, and 32.70° is 0.01297, 0.1231, and 0.2629, and that of *trans-trans*-dicyclohexyl at 0.2°, 23.26°, and 32.68° is 0.01619, 0.1577, and 0.3457. The v.p. of *cis*-1:2-dihydroxycyclohexane at 16.5°, 23.3°, and 47.0° is 0.06586, 0.09925, and 0.3626, and of the *trans*-compound 0.07608, 0.11244, and 0.40672. In all cases the v.p. of *trans*-compounds is > of *cis*-compounds in agreement with the higher dipole moments of the latter.

III. The v.p. of PhCl at -14.4°, -19.2°, and -24.5° is 0.9423, 0.7188, and 0.4963 mm. Hg; of PhBr at 26.1°, 0.3°, and -21.9° 0.9006, 0.1394, and 0.0114; of PhI at 26.1°, 0.3° and -21.9° 0.03742, 0.00285, and 0.00033; of *p*- $C_6H_4Cl_2$ at 0.3°, -10.0°, and -20.2° 0.9024, 0.4703, and 0.2354; and of *p*- $C_6H_4Br_2$ at 0.2°, -10.0°, and -19.2° 0.2019, 0.1073, and 0.0524. J. J. B.

Equation of state of gases. II. S. S. Vassiliev (*J. Phys. Chem. Russ.*, 1940, 14, 1139—1142).—Van der Waals' equation is less inexact for isotherms than when applied to isobars. J. J. B.

Compressions and polymorphic transitions of 17 elements to 10⁵ kg. per sq. cm. P. W. Bridgman (*Physical Rev.*, 1941, [ii], 60, 351—354; cf. A., 1940, I, 236; Goranson, *ibid.*, 332).—A preliminary report and discussion of data for Li, Na, K, Rb, Ca, Sr, Ba, Zn, Cd, In, Tl, Sn, As, Sb, Bi, Se, and Te. The steel and Carbonyl piezometer is immersed in a liquid which is itself exposed to a hydrostatic pressure of 25,000—30,000 kg. per sq. cm. New transitions have been found above 50,000 kg. per sq. cm. in Ca, Sr, Sb, Bi (two), and Te. N. M. B.

Liquid films in the viscous flow region. S. J. Friedman and C. O. Miller (*Ind. Eng. Chem.*, 1941, 33, 885—891).—Data reported for the average film thickness t , average velocity v , and max. velocity V of H_2O , PhMe, kerosene, and oil in a 1-in. glass tube in the region of viscous (streamline) flow [Reynolds no. (Re) < 1000] show that, although t agrees with vals. from the viscous flow equations, V/v , which should be 1.5 over the whole range, remains at this val. up to Re 25—30 and then rises sharply to 2.2 at Re 100, i.e., the gas-liquid interfacial velocity is > the theoretical, and waves appear in the liquid film. This indicates a change in flow mechanism, and the term pseudo-streamline flow is suggested. The Recfriction-factor correlation for true streamline flow is applicable to this region. I. C. R.

Viscosities of homologous series at equal temperatures. A. H. Nissan and A. E. Dunstan (*J. Inst. Petroleum*, 1941, 27, 222—225).— $\log \eta$ is connected more directly with mol. vol. than with mol. wt., and the formula $\log \eta = A \log (\text{mol. vol.}) + B$ is more widely applicable than $\log \eta = A (\text{mol. wt.}) + B$ (cf. A., 1939, I, 604). The formula is not, however, comprehensive. T. C. G. T.

Guest's law of elastic failure. B. R. Seth (*Proc. Indian Acad. Sci.*, 1941, 14, A, 37—40).—The theory of finite strain gives a criterion similar to that of Guest and contains the commonly adopted theories of max. shear stress. W. R. A.

Joule-Thomson effect in helium at low temperatures. J. L. Zelmanov (*J. Physics U.R.S.S.*, 1940, 3, 43—52).—The integral Joule-Thomson effect in He has been investigated at 60—20° K., and pressures up to 60 atm. The curves have a max. corresponding with the inversion of the differential effect. The inversion pressure varies almost linearly with the inversion temp. The inversion curve of He is compared with that for other gases, and it is shown that the law of corresponding states does not hold for He, at least with respect to the Joule-Thomson effect. A. J. M.

Radiometric effect in liquid helium. P. G. Strelkov (*J. Physics U.R.S.S.*, 1940, 3, 53—55).—The radiometric effect

is generally small in liquids. If the good thermal transmission of He II is due to thermal conductivity, there should be a very small radiometric effect; if it is a poor conductor, and its good transmission is due to a convection effect, a definite radiometric effect should be observed. At temp. from 4.2° to 2.19° K. the radiometric forces cause "attraction" towards the beam of light, which is the normal effect for liquids. There was, however, an abrupt reversal of the effect on passing through the λ -point. From 2.19° to 1.7° K. the radiometric inclination increases linearly with temp. A. J. M.

V.—SOLUTIONS AND MIXTURES (INCLUDING COLLOIDS).

Compressibility of nitrogen-hydrogen-ammonia mixtures at high pressures and temperatures. J. S. Kazarnovski, G. B. Simonov, and G. E. Aristov (*J. Phys. Chem. Russ.*, 1940, 14, 774—781).—The compressibility of two H_2 - NH_3 , one N_2 - NH_3 , and three H_2 - N_2 - NH_3 mixtures was measured at 150°, 200°, 250°, and 300°, up to 1640 atm. Using these vals. and the Beattie-Bridgman equation, the mol. vols. were calc. with a possible error of 1%. J. J. B.

Pressure of saturated vapour of liquids and binary liquid mixtures. III. N. D. Litvinov (*J. Phys. Chem. Russ.*, 1940, 14, 782—788).—The new method (cf. *ibid.*, 562) of calculating the consts. in Margules' equation is applied to the mixtures $CHCl_3 + CHI_3$, $CHI_3 + C_6H_6$, $CH_2(OMe)_2 + C_6H_6$, $CH_2(OMe)_2 + Et_2O$, $CHI_3 + Et_2O$, $CH_2(OMe)_2 + CHCl_3$, and $COMe_2 + C_6H_6$. The calculation is checked and confirmed by a few experiments. J. J. B.

Calculation of partial pressures of binary mixtures. R. M. Levy (*Ind. Eng. Chem.*, 1941, 33, 928—931).—Two semi-empirical simplified expressions are derived for calculating the relation between partial v.p. and liquid composition of binary mixtures; they depend on the accurate determination of two points on the total pressure or b.p. curves. I. C. R.

Compressibility of aqueous solutions of strong electrolytes. P. Prozorov (*J. Phys. Chem. Russ.*, 1940, 14, 384—390).—The velocity v of sound in solutions is measured using a supersonic interferometer and a frequency of 5×10^5 cycles per sec. v increases linearly with the concn. c (mol. per l.) of salt up to saturation; Na_2SO_4 shows the steepest and KBr the slowest rise. From v the compressibility β (in 10^{-6} atm.⁻¹) is calc. It is $\beta = \beta_0 - ac + \delta c\sqrt{c}$, and the coeffs. a and δ at 19—24° are: NaCl and $NaNO_3$ 7.05 and 1.41; KCl and KBr 6.30 and 1.25; KNO_3 6.65 and 1.43; $MgSO_4$ 16.2 and 4.7; $ZnSO_4$ 16.0 and 4.5; $CuSO_4$ 14.1 and 4.3; $CdSO_4$ 12.6 and 3.1; Na_2SO_4 16.95 and 4.5; Na_2SO_4 21.1 and 9.7; K_2SO_4 20.5 and 9.8. The form of the equation and the increase of the coeff. with the valency of ions agree with Debye's theory but the numerical vals. of the coeff. are \gg the theory predicts. The β val. for conc. NaCl and KNO_3 solutions is almost independent of temp. between 20° and 80°. J. J. B.

Compressibility of aqueous solutions of acids and organic liquids. P. Prozorov (*J. Phys. Chem. Russ.*, 1940, 14, 391—400; cf. preceding abstract).—The velocity of sound v as a function of concn. has a max. for 6.3M- H_2SO_4 , 6.6M- HNO_3 , ~2M-HCl, 5.2M-AcOH, and for 25—30 wt.-% of EtOH, $COMe_2$, and MeOH in 70—75% of H_2O ; the respective max. vals. are 1590, 1560, ~1550, 1560, 1640, 1600, and 1580 m. per sec. at 22—29°. The equation $\beta = \beta_0 - ac + \delta c\sqrt{c}$ is less exact for acids than for salts. H_2SO_4 has $a = 4.75$ and $\delta = 0.94$ between 3M. and 9M., and $a = 4.65$ and $\delta = 0.875$ above 9M.; HNO_3 has 3.95 and 0.834 above 3M.; HCl has 5.2 and 1.75; AcOH has 2.75 and 0.79 below 6M. and 3.2 and 1.01 above it. The v of H_2O increases, and that of EtOH decreases, with rise of temp.; the v of ~10% EtOH is independent of temp. The [EtOH] at which v is a max. is higher at 0° than at 70°. For EtOH, $COMe_2$, and MeOH solutions $\beta = \beta_0 - ag + bg^2$, where g is concn. in mols. per kg. of solution. β passes through a min., for which no explanation is offered. J. J. B.

Osmosis. II. Osmosis of salt solutions. R. Goto (*Kyoto Furitu Ika Daigaku Zassi*, 1939, 27, 213—230; *Rev. Phys. Chem. Japan*, 1941, 15, 64—65).—The rise of the H_2O column in a Yasumaru osmometer fitted with collodion capsules containing aq. KCl, NaCl, LiCl, $MgCl_2$, and $CaCl_2$ has been investigated. For uni-univalent electrolytes the larger is the

standard p.d. of the capsule and the lower is the salt concn. the longer is the time required for the column to reach its max. height. For the same standard p.d. and mol. concn. the val. of the max. height follows the order $K > Na > Li$. With uni-bivalent electrolytes the standard p.d. of the capsule is large and with very dil. solutions 50–70 hr. are required for the max. rise to be attained. J. W. S.

Measurement of electric losses in aqueous sulphuric acid. K. P. Mischtschenko, C. I. Vorakso, and L. I. Grudkova (*J. Gen. Chem. Russ.*, 1941, 11, 149–156).—The resonance of the system $H_2O-H_2SO_4$ at 17° falls abruptly to a min. at 0.1% H_2SO_4 , rises to a max. at 40%, falls to a secondary min. at 84%, and again rises to a secondary max. at 95% H_2SO_4 , above which concn. it falls abruptly. R. T.

Density and refractive index in the system methyl alcohol-acetone-methyl acetate. V. P. Sumarokov and M. I. Davidova (*J. Appl. Chem. Russ.*, 1941, 14, 256–263).—*d*- and *n*-composition curves are recorded for the systems $MeOH-MeOAc$, $COMe_2-MeOAc$, $MeOH-COMe_2$, and $MeOH-COMe_2-MeOAc$, at 20°. Except for the *d*-composition curve of the system $MeOH-COMe_2$, all curves are rectilinear. R. T.

Atomic arrangement in glass. B. E. Warren (*J. Amer. Ceram. Soc.*, 1941, 24, 256–261).—The development of the random network theory of the structure of the simple and complex glasses of SiO_2 , B_2O_3 , and P_2O_5 is outlined. The theories are based on X-ray diffraction studies, the laws of crystal chemistry, physical properties, and chemical compositions. The limits of immiscibility in the SiO_2-CaO system are calc. from the valency and size of the atoms, and the shifting of the lower CaO content with increase in temp. is predicted. J. A. S.

X-Ray study of soda-lime-silica glass. J. Biscoe (*J. Amer. Ceram. Soc.*, 1941, 24, 262–264).—X-Ray diffraction radial distribution curves for three glasses show that the Si is tetrahedrally bonded to 4 O, each O being bonded to 1 or 2 Si. If each Na is assumed to be surrounded by 6 O, each Ca must be surrounded by ~7 Ca. A qual. correlation of the structure with *d* and coeff. of thermal expansion is made. J. A. S.

The α/β brass type of equilibrium. K. W. Andrews and W. Hume-Rothery (*Proc. Roy. Soc.*, 1941, A, 178, 464–473).—Measurements of the lattice spacing of the α and β phases of Cu–Zn at temp. between 300° and 870° were made. Similar measurements were made at 672° on the α and β phases of alloys of Cu with In, Sn, Ge, and Al. The spacing of Cu from 18° to 871° was also determined. Plots from the data obtained show the relation between (a) vol. per atom and electrons per atom of the phases in equilibrium, and (b) vol. per electron and electrons per atom. Certain features of these diagrams are discussed. G. D. P.

Equilibrium diagram of the alloy Ag–Sn. M. M. Umanski (*J. Phys. Chem. Russ.*, 1940, 14, 846–849).—X-Ray analysis was used. The boundary between the α phase and a mixed phase lies at 9.5 and 11.1 at.-% of Sn at 218° and 600°, respectively; that between the mixed phase and β phase lies at Sn 11.7 and 12.4 at.-% at 218° and 600°; and that between the β and γ phase at Sn 17.7 and 21.3 at.-% at 218° and 400°. The γ -phase forms a rhombic lattice with *a* 2.992, *b* 5.152, and *c* 4.77 Å. J. J. B.

Solubility of manganese in aluminium containing up to 2% of magnesium. E. Fahrenhorst and W. Hofmann (*Metallurg.*, 1940, 19, 891–893).—Resistivity measurements were made on Al–Mn alloys containing up to 5% of Mn, and on Al–Mn–Mg alloys containing up to 2.5% of Mn and 2% of Mg. The solid solubility of Mn in pure Al at 500°, 550°, and 600° is 0.34, 0.60, and 0.96%, respectively. These vals. are reduced to 0.26, 0.45, and 0.80%, respectively, by addition of 2% of Mg. C. E. H.

Electron diffraction and surface structure of the acid-resistant alloy ferrosilicon (Duriron) in sulphuric acid. S. Yamaguchi (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, 38, 409–413).—Specimens of Duriron (Si 14.5%) immersed in 10–30N- H_2SO_4 and afterwards examined by electron diffraction show the presence of α -cristobalite in the surface layer. It is considered to be formed by oxidation of part of the Si remaining after dissolution of the surface Fe, the other part of the Si becoming cryst. F. L. U.

Limited mutual solubility of gases at high pressures. I. R. Kritschewski (*J. Phys. Chem. Russ.*, 1940, 14, 434).—A mixture of NH_3 67.6% and N_2 32.4% separates at 140° and 5000 kg. per sq. cm. into two layers; the upper layer contains 76.6% and the lower layer 33.1% of NH_3 . Both are gaseous. J. J. B.

Solubility of chlorine in water. R. P. Whitney and J. E. Vivian (*Paper Trade J.*, 1941, 113, TAPPI Sect., 107–108).—The solubility of Cl_2 in H_2O has been determined experimentally over the range of temp. and liquid concn. commonly met with in the prep. of aq. Cl_2 bleaching solutions. The absorption coeffs. previously reported (B., 1940, 602) have been recalcd., with the result that they are raised ~10%. H. A. H.

Nomograph for the solubility of chlorine in water. D. S. Davis (*Ind. Eng. Chem.*, 1941, 33, 1202).—From the data of Whitney and Vivian (A., 1941, 1, 372) a nomograph is constructed permitting calculation of the solubility of Cl_2 at 0–1 atm. and 10–25° (cf. preceding abstract). J. W. S.

Solubility of carbon dioxide from its mixtures with hydrogen and nitrogen in water under pressure. S. D. Saalischvili (*J. Phys. Chem. Russ.*, 1940, 14, 413–417).—The solubility, measured for three mixtures of CO_2 (20–31%) with H_2 and N_2 , three pressures (16–49 atm.), and three temp. (20–50°), is \propto the fugacity of CO_2 calc. from the Beattie–Bridgman equation, independently of pressure and concn. At a fugacity of 10 atm. 1 mol. of H_2O dissolves at 20° 7×10^{-3} , at 35° 5.8×10^{-3} , and at 50° 4×10^{-3} mol. of CO_2 . J. J. B.

Solubility of acetylene and carbon dioxide in liquid nitrogen and liquid oxygen. M. F. Fedorova (*J. Phys. Chem. Russ.*, 1940, 14, 422–426).—The solubility (mol. fractions $\times 10^6$ and abs. temp.) of solid C_2H_2 in liquid O_2 is 0.641, 2.04, and 10.85 at 65.1°, 78.9°, and 98.0°; and in liquid N_2 0.791, 2.72, and 19.95 at 65.0°, 79.4°, and 95.0°. The solubility of solid CO_2 in O_2 is 1.77, 2.91, and 5.61, and in N_2 2.21, 3.47, and 7.26 at 67.0°, 78.4°, and 98° respectively. All these vals. are < those predicted by Hildebrand. J. J. B.

Solubility of gases in liquids at low temperatures and high pressures. III. Solubility of hydrogen in liquid methane. V. G. Fastovski and M. G. Gonikberg (*J. Phys. Chem. Russ.*, 1940, 14, 427–428).—The distribution of H_2 between liquid and vapour is measured between 90° and 127° K. at 32–234 atm. At 90.3° when the vapour contains 96.8 mol.-% of H_2 , the liquid contains 2.4 and 8.1 mol.-% of H_2 at 49 and 164 atm. At 127° with 86% of H_2 in the vapour the liquid contains 3.8% and 14% of H_2 at 37 and 131 atm. Henry's law is valid for these solutions. J. J. B.

Solubility of ethylene and propylene in liquid nitrogen and liquid oxygen. N. M. Zin (*J. Phys. Chem. Russ.*, 1940, 14, 418–421).—The solubility of solid C_2H_4 in liquid O_2 (mol. fractions and abs. temp.) is 0.00065 at 69°, 0.0142 at 90.1°, and 0.1743 at 101°; and in liquid N_2 0.00054 at 69° and 0.011 at 90.1°. The solubility of solid C_3H_6 in liquid O_2 is 0.00202, 0.0282, and 0.385 at 67°, 80.6°, and 86.5°; and in N_2 0.0017 and 0.072 at 67° and 83°. Both solubilities are < those predicted by Hildebrand's theory for non-polar solutions, and they do not change linearly with $1/T$. J. J. B.

Absorption rates of carbon dioxide in sodium carbonate solutions. Effects of impurities and of surface tension. J. H. Smith and E. L. Quinn (*Ind. Eng. Chem.*, 1941, 33, 1129–1131).—The rate of absorption of CO_2 by 2N- Na_2CO_3 is reduced by adding Na_2SO_4 , the decrease being almost \propto the $[Na_2SO_4]$ over the concn. range 0–1.5N. Reduction of the surface tension of the absorbing solution from 78 to 33 dynes per cm. by adding detergents increases the rate of absorption by nearly 30%. J. W. S.

Solubility of di-*n*-propylamine. R. W. Hobson, R. J. Hartman, and E. W. Kanning (*J. Amer. Chem. Soc.*, 1941, 63, 2094–2095).—The system $NHPr^a-H_2O$ gives a crit. solution temp. of –4.8° with 66 wt.-% of H_2O . The system $NHPr^a-H_2O-EtOH$ has been investigated at 25°. W. R. A.

Structure of pseudo-mixed crystals of the type barium nitrate-methylene-blue. V. G. Chlopov and M. A. Tolstaja (*J. Phys. Chem. Russ.*, 1940, 14, 941–952).—Methylene-blue (I) is pptd. together with $Ba(NO_3)_2$ or $Pb(NO_3)_2$ if the solution contains >0.002% or >0.0002% of (I), respectively. At concns. near this min. the $Ba(NO_3)_2$ and $Pb(NO_3)_2$ crystals are partly coloured. The entrainment of (I) is not ordinary

adsorption as it is almost unaffected by salts which are strongly adsorbed by ppts.; e.g., 7% of $\text{Th}(\text{NO}_3)_4$ added to $\text{Ba}(\text{NO}_3)_2$ increases the min. concn. to 0.003% only. The entrainment of (I) is not due to a formation of mixed crystals as the distribution of (I) between ppt. and solution does not follow the Berthelot-Nernst rule. Electron diffraction patterns of $\text{Ba}(\text{NO}_3)_2$ containing (I) show lines of both compounds. (I) is included in $\text{Ba}(\text{NO}_3)_2$ crystals in the form of small crystals; there is no interpenetration of the lattices. Regions of the $\text{Ba}(\text{NO}_3)_2$ lattice are included in (I) crystals when, e.g., 0.3% of $\text{Ba}(\text{NO}_3)_2$ is added to a saturated solution of (I); this inclusion is not prevented by $\text{Th}(\text{NO}_3)_4$. Ra salts are taken up by crystallising (I) but this adsorption ceases in presence of 0.2% of $\text{Th}(\text{NO}_3)_4$. J. J. B.

Adsorption of hydrogen by an ideal metal. R. C. L. Bosworth (*J. Proc. Roy. Soc. N. S. Wales*, 1940, **74**, 538—548).—Theoretical. The interaction between a H atom and its electric image in an ideal metal has been calc. by considering the mutual energy of the atom and its image as a perturbation of the normal H orbitals. When the atom is 1.0 Å. from the surface the interaction energy is a min. and represents a bonding energy of 15,200 g.-cal. per mol. At this point the dipole moment is -0.37 D. Data for the adsorption of H on K and on W are in satisfactory agreement with calculations. C. R. H.

Interchange of hydrogen in the adsorbed film on tungsten. D. D. Eley (*Proc. Roy. Soc.*, 1941, **A**, **178**, 452—464).—Films of W were prepared which bring the reactions $p\text{-H}_2 \rightleftharpoons o\text{-H}_2$ and $\text{H}_2 + \text{D}_2 \rightleftharpoons 2\text{HD}$ to equilibrium in a few min. at 77° K. Their surface area is estimated at $\sim 450 \text{ cm}^2$. A WH film prepared by contact of an evaporated W film with H_2 showed a rapid interchange with D_2 at 193° and 293° K. The data lead to an estimate of the effective area in agreement with that already given. It appears that H and D are equally strongly adsorbed on W at 293° K. but at 77° the equilibrium is displaced in favour of D in the gas phase. It was concluded that at 77° only 20—40% of the chemisorbed D is sufficiently reactive to interchange with gaseous H. This may be due to a small variation of WD adsorption energy over the surface. (Cf. A., 1941, **I**, 477.) G. D. P.

Adsorption and desorption of sulphur trioxide on catalysts used for oxidising sulphur dioxide. N. I. Pevni (*J. Phys. Chem. Russ.*, 1940, **14**, 981—984).—At 150—240 mm. Hg and 450—500° in 4 hr. (no equilibrium was attained) SO_3 is adsorbed most by Ba-V catalyst, then by Ba-Al-V > Cr-Sn-Sb > Pt on asbestos > Pt on SiO_2 gel. For the relative rate v of desorption at 450° and for the % P of the SO_3 liberated on evacuation the order observed is: Cr-Sn-Sb > Pt on asbestos > Pt on SiO_2 gel > Ba-Al-V > Ba-V. P is 35% of the adsorbed amount for Cr-Sn-Sb and 16% for Ba-V; these vals. are reached in 2—3 hr. and do not change on a more prolonged evacuation. The catalytic efficiency for oxidation of SO_2 at 450° falls off in the order Cr-Sn-Sb > Ba-Al-V > Pt > Ba-V. It is similar to that for v ; efficient catalysts do not retain the reaction product for long. At 500° both v and the catalytic efficiency are almost independent of the catalysts used. J. J. B.

Adsorption of iodine vapour by silica aerogel. L. N. Kurbatov (*J. Phys. Chem. Russ.*, 1940, **14**, 1111—1117).—The amount adsorbed \propto the v.p. of I up to 0.1 mm. Hg. From the temp. coeff. between 10° and 40° the heat of adsorption is calc. to be 10,800 g.-cal. per mol. At room temp. 1 g. of aerogel adsorbs 0.041 g. of I. The absorption spectrum of adsorbed I has a max. at 490 m μ . when the adsorption is small, and at 515 m μ . when it is large. The shift of the max. from 500 m μ . (for I vapour) to 490 m μ . is due to polarisation of adsorbed I mols., and the shift to 515 m μ . is a purely optical effect due to using not strictly monochromatic light. J. J. B.

Photochemical properties of iodine sorbed by thallium iodide. L. N. Kurbatov (*J. Phys. Chem. Russ.*, 1940, **14**, 1049—1053).—In I vapour saturated at room temp. TI₂ absorbs 2 I atoms per mol.; when I vapour is frozen out at 0° the composition of the adsorbent corresponds with 5TI₂.TI₂. This compound is dark grey; when it is illuminated it is bleached, especially in green light, and loses some I. A scarcely visible image produced by illumination is intensified if more I vapour is introduced. When I vapour is permanently present the bright image produced by light becomes almost black on longer exposure. The light absorption by these images is measured. The development of images by I

vapour is presumably due to a difference between the condensation centres on illuminated and untreated adsorbent.

J. J. B.

Adsorption of organic vapours on organic adsorbents studied by extinction of fluorescence. S. P. Tibilov (*J. Phys. Chem. Russ.*, 1940, **14**, 953—963).—Fluorescence of palmitic acid (I) (specially prepared, cf. Talmud, A., 1940, **I**, 22) and of an aerogel of paraffin wax (II) is excited by $\lambda\lambda$ 250—360 m μ ; its intensity is identical for (I) and (II) and has a min. at 280 m μ . and a relative max. at 330 m μ . The fluorescence spectrum between 420 and 590 m μ . is identical for (I), (II), and paraformaldehyde. The fluorescence is not affected by vapours of CHCl_3 , COMe_2 , C_6H_6 , PhCl , CO , CO_2 , O_2 , NH_3 , EtBr , and H_2O . It is reduced by 50% in presence of 0.01—0.03 mm. Hg of benzoquinone, 0.04—0.05 mm. of PhNO_2 , 0.2—0.5 mm. of NPhMe_2 , 0.3 mm. of NH_4Ph , and 3.4—9.4 mm. of Ac_2 ; CCl_4 reduces the intensity by <50%. The relative reduction W of fluorescence is a linear function of the v.p. p for Ac_2 , and seems to tend to a limit for other vapours. A theory assuming W to be \propto the concn. of vapour mols. in the adsorption layer gives a linear relation between p/W and p which is also valid for Ac_2 . NH_3 at 10 mm. lowers W caused by Ac_2 on (I) at low p of Ac_2 but not at high p . Adsorption during irradiation is different from that in the dark. Benzoquinone adsorbed by (II) in darkness is quantitatively liberated in 20 min. in a vac., but when the adsorption has taken place in the ultra-violet, W after 20 min. of pumping out is still 56%. The fluorescence of org. solids is not due to an internal photo-effect as it is not extinguished by substances having a high electron affinity. Ultra-violet radiation excites mols. of (I) etc., and the excess energy is given up to benzoquinone etc. when such substances are present. J. J. B.

Primary sorption of water by cotton. S. M. Neale and W. A. Stringfellow (*Trans. Faraday Soc.*, 1941, **37**, 525—532).—The sorption of H_2O vapour by bleached cotton yarn was measured at 10° intervals from 20° to 80° at pressures <1 mm. The graphs of $\log p$ against $1/T$ are linear and show a differential heat of sorption of 15.7 kg.-cal. per g.-mol., const. over the range studied. Since this val. is too high for a single H or OH bond it is suggested that in the primary stage each H_2O mol. is linked to a pair of suitably placed cellulose OH. F. L. U.

Adsorption of electrolytes from non-aqueous solutions. I. D. N. Strashesko (*J. Phys. Chem. Russ.*, 1940, **14**, 964—980).—Adsorption on ash-free charcoal is measured. The amount of HgCl_2 adsorbed decreases in the order $\text{H}_2\text{O} > \text{C}_6\text{H}_6 > \text{EtOH}$, COMe_2 , $\text{Et}_2\text{O} > \text{EtOAc}$; for CdI_2 the order is $\text{H}_2\text{O} > \text{Et}_2\text{O} > \text{EtOH}$, $\text{COMe}_2 > \text{EtOAc}$, for AgNO_3 , $\text{COMe}_2 > \text{H}_2\text{O}$, EtOH , for CuCl_2 , EtOH , COMe_2 , $\text{EtOAc} > \text{H}_2\text{O}$, for CoCl_2 , $\text{COMe}_2 > \text{EtOH}$, $\text{EtOAc} > \text{H}_2\text{O}$, for ZnCl_2 , $\text{Et}_2\text{O} > \text{COMe}_2$, EtOAc , EtOH , H_2O , for NH_4CNS , $\text{H}_2\text{O} > \text{EtOAc} > \text{EtOH} > \text{COMe}_2$, for KI , $\text{H}_2\text{O} > \text{EtOAc}$, COMe_2 , EtOH , and for LiCl , $\text{EtOAc} > \text{H}_2\text{O}$, $\text{COMe}_2 > \text{EtOH}$. The order of salts does not change much with solvent; in H_2O it is $\text{HgCl}_2 > \text{CdI}_2 > \text{AgNO}_3 > \text{NH}_4\text{CNS} > \text{CuCl}_2 > \text{ZnCl}_2 > \text{CoCl}_2 > \text{KI} > \text{LiCl}$, and in EtOAc , $\text{CuCl}_2 > \text{CoCl}_2 > \text{LiCl}$, Hg_2Cl_2 , $\text{NH}_4\text{CNS} > \text{ZnCl}_2$, $\text{CdI}_2 > \text{KI}$. The results can be represented by Freundlich isotherms. J. J. B.

Adsorption of alcohols at liquid interfaces in its relation to the nature of the phases in contact. E. M. Spivakova (*J. Phys. Chem. Russ.*, 1940, **14**, 406—412).—The interfacial tension σ of the boundaries H_2O /vapour, H_2O /heptane, and H_2O / PhNO_2 is lowered by alcohols in the order $n\text{-C}_6\text{H}_{13}\text{-OH} > \text{iso-C}_5\text{H}_{11}\text{-OH} > \text{BuOH} > \text{EtOH}$. σ of the H_2O /heptane boundary is lowered also by cetyl alcohol. BuOH , $\text{iso-C}_5\text{H}_{11}\text{-OH}$, and $n\text{-C}_6\text{H}_{13}\text{-OH}$, but not EtOH , lower the σ of PhNO_2 /vapour; no alcohol affects σ of the heptane/vapour interface. The calc. adsorptions vals. give $25\text{—}27 \times 10^{-16} \text{ cm}^2$ for the area taken up by an alcohol mol. in the saturated adsorption layer independently of the alcohol, and the boundary shows an identical orientation of alcohol mols. in all cases. Alcohols reduce the σ at the H_2O / PhNO_2 boundary although their σ is < that of PhNO_2 , contrary to a rule of Rehbinder. J. J. B.

Surface tension in binary and ternary mixtures of oxides. P. P. Kozakevitch and A. F. Kononenko (*J. Phys. Chem. Russ.*, 1940, **14**, 1118—1127).—The surface tension γ is calc., with an error of 1—2%, from the inward pull exerted by the melt on a Pt-Ir cylinder, at 1400—1425°. γ of FeO is 581—

592 ergs per sq. cm. It is reduced by SiO_2 , and the reduction \propto the mol. fraction n of SiO_2 ; when $n = 0.36$ $\gamma = 412$. TiO_2 behaves like SiO_2 but is less surface-active. MnO and Al_2O_3 slightly reduce, and Cr_2O_3 does not affect, γ of FeO . The system $\text{FeO}-\text{CaO}$ has a min. γ (~ 540) at $n \sim 0.15$ of CaO ; the lowering of γ by small amounts of CaO is probably due to salting-out of Fe_3O_4 present in FeO , and the increase by large amounts of CaO to the formation of a ferrite. 5% of $\text{P}_2\text{O}_5 + 5\%$ of Al_2O_3 lowers γ to 437. SiO_2 reduces γ of $\text{FeO}-\text{CaO}$ mixtures; large additions of SiO_2 are relatively more active than small ones, which are neutralised by CaO .

J. J. B.

Influence of electrolytes on the surface tension of eosin G solutions. P. I. Lebed (*J. Phys. Chem. Russ.*, 1940, 14, 432—433).—Addition of 0.017% of Na eosin slightly raises the σ of H_2O and slightly lowers that of NaCl , NaBr , KI , or KBr solutions at 20°, 30°, and 40°. The method of max. bubble pressure was used.

J. J. B.

Surface potentials of solutions of amino-acids and proteins. V. A. Ptschelin (*J. Phys. Chem. Russ.*, 1940, 14, 1085—1102).—The surface tension σ of glycine and alanine solutions in 0.01N-KCl increases with their concn. c . The surface potential ΔE , referred to that of 0.01N-KCl, also increases with c but remains $<$ that of fatty acids of the same chain length. ΔE of glycine, alanine, and tryptophan increases with c and with the acidity of the solution, and ΔE for tyrosine and cystine is greater in acid than in alkaline solution. ΔE of leucine has a max. at p_H 2—3 and a min. at p_H 11; the σ of leucine has a min. at p_H 2.5 and a max. at p_H 6—7. The ΔE of gelatin increases with c except at 0.05—0.5 g. per l., when it is independent of c because of the formation of a surface gel of gelatin; it has a max. at p_H 3. "Insol." gelatin fractions behave like untreated gelatin, and "sol." gelatin gives ΔE regularly increasing with c . ΔE of albumin (serum- and egg-) also increases regularly with c . The results are commented on from the point of view of the dipole theory of surface potentials.

J. J. B.

Effect of films of surface-active substances on the rate of evaporation of solutions. II. S. I. Skljarenko, M. K. Baranov, and K. I. Meshueva (*J. Phys. Chem. Russ.*, 1940, 14, 839—843).—Evaporation of surface-active volatile substances is rapid because of the stirring of the surface layer caused by evaporation. When this stirring is eliminated by a film of a non-volatile surface-active compound the rate v of evaporation is lowered; in this case the nature of the film is irrelevant. Thus, the evaporation of amyl acetate from an aq. solution is retarded by cetyl alcohol (I), oleic, palmitic, and stearic acid. When the volatile substance is not at all or but little surface-active, its evaporation is not helped by stirring, and is retarded only by films of poor permeability. Thus v of H_2S from 0.05% aq. solution and of NH_3 from 5—23% aq. solution is lowered by (I) but not by the acids. (I) reduces v of NH_3 to 1/9, of H_2O from NH_3 solution to 1/4, of H_2S to 1/1.7, and of H_2O from H_2S solution to 1/2; films of (I) show different permeabilities for different substances.

J. J. B.

Foam formation and foam stability. Effect of the adsorbed layer. G. K. A. Pankhurst (*Trans. Faraday Soc.*, 1941, 37, 496—505).—A modified method of measuring foam stability is described, and has been used in the study of solutions of saponin, Na alkyl sulphates, commercial wetting agents, Na oleate, ricinoleate, and sulphoricinoleate, and gelatin. Parallel measurements of the surface tension γ show that low vals. of γ do not ensure stability, although in some cases the optimum foam concn. corresponds with a high val. of $d\gamma/dc$. Stability of foam requires cohesion in the adsorbed layer. Introduction of additional hydrophilic groups into a mol. impairs its foaming properties. The max. foam production for various kinds of gelatin occurs at p_H vals. slightly above but not coincident with the isoelectric point. The foaming properties of gelatin can be greatly modified by small amounts of capillary-active impurities.

F. L. U.

Fixation of mineral particles in the surface of air bubbles in flotation. Z. V. Volkova (*J. Phys. Chem. Russ.*, 1940, 14, 789—800).—Equations for the adhesion between particles and bubbles and for the rise of loaded bubbles in liquid are derived. The particles break off more easily when the bubbles rise with an acceleration. When the bubbles move at a const. speed and there is a relation between the bubble size, particle size, and contact angle θ . If θ is const. small particles adhere to small bubbles, and large bubbles rising in a fine suspension often do

not carry any particles. The smaller is θ the larger is the bubble to which particles of a given size preferentially adhere. If θ and particles are large, attachment of two large particles to a small bubble becomes predominant. These results of the theory are confirmed by photomicrographs of flotation froth.

J. J. B.

Study of thin layers of organic substances at the mercury-solution interface by capacity measurements. Compression and expansion of surface layers. A. Gorodetskaja (*J. Phys. Chem. Russ.*, 1940, 14, 371—373).—An apparatus is described for compressing surface films on a Hg-solution interface. The capacity of a $\text{Hg}|\text{N}-\text{Na}_2\text{SO}_4 + 0.002\text{N}-\text{H}_2\text{SO}_4$ electrode at -0.2 v. relative to the electrocapillary max. is 21 μF . per sq. cm., and is lowered to 9 and 5 by 2 and 12×10^{-10} mol. of myristic acid per sq. cm. respectively. When crystals of myristic acid or cetyl alcohol swim on the Hg the capacity is < 2 . Presumably the films having $> 4 \times 10^{-10}$ mol. per sq. cm. are not uniform and contain islets in equilibrium with a dil. monolayer.

J. J. B.

Electron diffraction of multilayers of esters of fatty acids. I. A. Cameron and G. D. Coumoulos. II. Structure of multilayers of the esters. G. D. Coumoulos and E. K. Rideal (*Proc. Roy. Soc.*, 1941, A, 178, 415—420, 421—428).—I. The orientation of the long axis of long-chain org. mols is revealed by electron diffraction patterns of inclined specimens.

II. The results obtained from Me and Et stearates and octadecyl acetate in very thin multilayers show that the substances possess the orthorhombic structure of the α modification. The multilayer state is transient and is replaced by an aggregation of micro-crystals with "fibre" orientation.

G. D. P.

Semi-permeability. C. Jung (*Arch. Sci. phys. nat.*, 1941, [v], 23, Suppl., 100—102).—A Cellophane membrane is shown to be permeable to $\text{CO}(\text{NH}_2)_2$ but impermeable to glucose. The rate of passage of H_2O through the membrane owing to hydrostatic pressure is not comparable with its rate of passage through osmosis. This can be explained by assuming that only some of the pores are semi-permeable whilst the others allow solution to pass through them.

J. W. S.

Structure of collodion membrane and its electrical behaviour.

II. Activated collodion membrane. K. Sollner, I. Abrams, and C. W. Carr (*J. Gen. Physiol.*, 1941, 25, 7—27; cf. A., 1941, I, 258).—The electrochemical behaviour (concn. potential, anomalous osmosis, etc.) of collodion membranes is due to acidic impurities which determine the charge density of the collodion-aq. solution interface. This charge density probably corresponds with the base-exchange capacity of the interface. Commercial collodion preps. are too pure to yield membranes of sufficient activity for electrochemical studies, whilst crude collodion shows considerable activity. Inactive collodion preps. are readily activated by oxidation, which increases the no. of dissociable groups (CO_2H) on the collodion. The best oxidising agents are NaOCl , $\text{Ca}(\text{OCl})_2$, NaOBr , and conc. alkali, and full details are given for the activation of dried and porous collodion, and collodion in bulk. Membranes oxidised by these methods show a much higher electrochemical activity than any previously described, and oxidised highly dried membranes give concn. potentials which approach the thermodynamically possible max. Oxidised porous membranes show greatly increased concn. potentials and yield considerably greater electro-osmosis when a current is passed through them. The behaviour of porous membranes towards non-electrolytes is changed only slightly by oxidation, and the vol. and % H_2O content (pore space) remain practically const. Collodion oxidised in bulk also yields very active dried and porous membranes. Membranes prepared from different collodion preps. which behave fairly uniformly towards non-electrolytes but very differently towards electrolyte solutions become similar in their behaviour towards electrolytes after oxidation. The geometrical structures of membranes prepared from different collodion preps. and from oxidised collodion are essentially identical, and the differences in their behaviour towards electrolytes are due entirely to the electrochemical factor.

J. N. A.

Properties of aqueous colloidal sterol solutions.—See A., 1941, III, 921.

Macromolecular properties of linear polyesters: mol. wt. of ω -hydroxyundecic self-polyesters. W. O. Baker, C. S. Fuller, and J. H. Heiss, jun. (*J. Amer. Chem. Soc.*, 1941, 63,

2142—2148).—15 strictly isochemical linear self-polyesters derived from ω -hydroxyundecic acid including the average chain-length range 13 to 1440 (wt. average) chain atoms have been investigated by titration, solution viscosity (η), melt viscosity, and precipitability methods. Each measurement yields consistent vals. for the suitable average mol. wt. and supports the mol. distribution statistics of Flory and Schulz. The solution methods require careful choice of polymeric concn., particularly in the application of the Staudinger or Arrhenius equation. The concn.-dependence of η and its systematic relationship to chain length are indicated. The kinetic behaviour of the chain polymerides suggests the coupled action of separate sections in a given chain. The relationship between entropy and polymeric solubility is discussed. W. R. A.

Similarity of cellulose with rubber and the production of artificial cellulose threads as a macromolecular process. P. H. Hermans (*Naturwiss.*, 1940, 28, 264).—Priority over Kargin *et al.* (A., 1940, I, 71) is claimed. A. J. M.

Action of gelatin gels in sodium chloride solution. T. Hasegawa (*Bull. Japanese Soc. Sci. Fish.*, 1940, 9, 61—63; *Rev. Phys. Chem. Japan*, 1941, 15, 68—69).—The changes in wt., H_2O content, and NaCl content of gelatin cubes during various periods of immersion in 0—20% aq. NaCl have been investigated. The processes involved are similar to those during fish curing. J. W. S.

Dielectric behaviour of solutions of gliadin. P. P. Entrikin (*J. Amer. Chem. Soc.*, 1941, 63, 2127—2131).—Experimental dispersion of dielectric const. data for three different fractions of gliadin in 56% aq. EtOH at 25° has been studied in the frequency range 2.5×10^4 to 3×10^7 cycles per sec., and is quantitatively accounted for by assuming an ellipsoid mol. by a combination of the Debye dipole theory and the Perrin hydrodynamics of elongated particles. The mol. wt. is 38,000 and the ratio of the major to the minor axis of the gliadin unit is 8. Physical consts. are tabulated and diffusion consts. compared with other existing data. W. R. A.

Heats of organic reactions. XI. Denaturation of pepsin by alkali. J. B. Conn, D. C. Gregg, G. B. Kistiakowsky, and R. M. Roberts (*J. Amer. Chem. Soc.*, 1941, 63, 2080—2085).—The difference between the heats of reaction of native and denatured pepsin with KOH at 30° has been termed the heat of denaturation and depends on the initial and final p_H vals. Between p_H 4.3 and 8.2 it is 85 kg.-cal. per mol. but decreases with increasing p_H . Treatment with alkali appears to affect heat of denaturation and enzymic activity somewhat similarly but the effects are to some extent independent. W. R. A.

Isoelectric points of acetylated and deaminated cucurbitin. —See A., 1941, III, 922.

Electrophoretic purification of cytochrome-*c* and its amino-acid composition. Titration curves.—See A., 1941, III, 793.

VI.—KINETIC THEORY. THERMODYNAMICS.

Approximate calculation of free energy and equilibrium constant from thermochemical values, and its application. W. Sakai (*Tech. Rep. Kyushu Imp. Univ.*, 1939, 14, 263—298; *Rev. Phys. Chem. Japan*, 1941, 15, 67).—Approx. formulæ for calculating ΔG and equilibrium consts. of a reaction from thermochemical data are compared with thermodynamical equations expressing their variation with temp. J. W. S.

Investigation of the cyclohexane-methylcyclopentane equilibrium by means of the Raman effect. S. I. Mizushima, Y. Morino, and R. Fujisiro (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, 38, 401—408).—Raman spectra of the liquid obtained by boiling cyclohexane (I) with moist $AlCl_3$ contain no lines other than those of (I) and methylcyclopentane (II). The % of (II) in the equilibrium mixture increases with rise of temp. from 12 at 25° to 23 at 70°. The entropy change calc. from these results and the relevant thermal data agrees with that obtained by the statistical method from mol. data. F. L. U.

Dissociation constant of azoimide. N. Yui (*Bull. Inst. Phys. Chem. Res. Japan*, 1941, 20, 390—398).—From titrations of aq. HN_3 with NaOH and of NaN_3 with HCl and measurement of p_H with a glass electrode a mean val. of 2.16×10^{-8} is found for K . On the basis of e.m.f. measure-

ments with the cell $H_2|acetate\ buffer|glass|HN_3(m_1), NaN_3(m_2), NaCl(m_3), AgCl|Ag$ at various ionic strengths the val. obtained is 1.91×10^{-8} . F. L. U.

Dissociation constant of hydrogen selenide. H. Hagiwara (*Bull. Inst. Phys. Chem. Res. Japan*, 1941, 20, 384—389).—The first and second ionisation consts. of H_2Se in aq. solution are respectively 1.30×10^{-4} and 1×10^{-11} at 25°. F. L. U.

Electrolytic dissociation of complex cyanides of iron. B. V. Nekrassov and G. V. Zotov (*J. Appl. Chem. Russ.*, 1941, 14, 264—269).—The dissociation coeffs. of the first and second H atoms of $H_4[Fe(CN)_6]$ and of all three H of $H_3[Fe(CN)_6]$ are of the same order of magnitude as is that of HCl. Those of the third and fourth H of $H_4[Fe(CN)_6]$ are, respectively, 10^{-3} and 5×10^{-5} . R. T.

Dissociation constants and stereochemistry of some stereoisomeric dibasic acids. J. C. Speakman (*J.C.S.*, 1941, 490—495).—The first and second dissociation consts. of the *cis*- and *trans*-forms of dibasic acids derived from cyclopentane, cyclohexane, and tetrahydronaphthalene and of the two forms of perhydrodiphenic acid with m.p. 220° and 244°, respectively, have been measured by the author's method (A., 1940, I, 359). The results are in accord with the generally accepted hypothesis that the potential barriers restricting free rotation about the C—C linking are such as to favour a "staggered" configuration around each linkage. A simple method of reckoning the average spatial separation of any two members of a saturated and strainless system of C atoms is developed. J. W. S.

Inorganic oxychlorides as hydrogen-bonding solvents. L. F. Audrieth and R. Steinman (*J. Amer. Chem. Soc.*, 1941, 63, 2115—2116).—Measurements of heats of mixing of $CHCl_3$ with inorg. oxychlorides show that H-bonding takes place involving formation of C—H—O linking. The strength of the bond is materially diminished by the presence of Cl atoms in the donor mol., whilst the corresponding esters with Cl replaced by the less negative OEt are much better H-bonding solvents. W. R. A.

Composition of the vapour of equimolecular mixtures. V. A. Kireev (*J. Phys. Chem. Russ.*, 1940, 14, 996—1003).—For the mol. fraction m of a component A in the vapour of an equimol. mixture of A and B , $m = p_A/(p_A + p_B)$, p_A and p_B being the v.p. of the pure components. This equation is verified for ~100 mixtures of liquids which do not dissociate electrolytically and the vapours of which behave like perfect gases. It can also be used for computing m at various temp. The equation is deduced theoretically on the assumption that the heat of mixing shows a max. for equimol. mixtures. J. J. B.

Two-phase equilibrium in binary and ternary systems. IV. System ethane-propylene. H. Lu, D. M. Newitt, and M. Ruhemann (*Proc. Roy. Soc.*, 1941, A, 178, 506—525; cf. A., 1940, I, 413).—The liquid-vapour equilibrium of the system was studied in the temp. range —30° to 70° and between 1 and 50 atm. The experimental data are tabulated. G. D. P.

Transition phenomena involving decahydrated mixed crystals of sodium sulphate and sodium chromate. W. E. Cadbury, jun., W. B. Meldrum, and W. W. Lucasse (*J. Amer. Chem. Soc.*, 1941, 63, 2262—2267).—The transition of mixed crystals of $Na_2SO_4 \cdot 10H_2O$ and $Na_2CrO_4 \cdot 10H_2O$ into hexa- and tetrahydrated and anhyd. crystals and solution has been investigated and the relation between temp. and composition of the solution in equilibrium with the decahydrate and another solid phase has been determined. The existence of mixed crystals of $Na_2SO_4 \cdot 6H_2O$ and $Na_2CrO_4 \cdot 6H_2O$, and the lowering of the temp. at which $Na_2CrO_4 \cdot 6H_2O$, $Na_2CrO_4 \cdot 4H_2O$, and solution are in equilibrium have been established. When $[Na_2SO_4]$ is low in the mixed crystals ($10H_2O$) the solid transition products are mixed crystals, usually of hexa- but sometimes of tetrahydrate, whereas with a high $[Na_2SO_4]$ anhyd. Na_2SO_4 is formed. W. R. A.

Binary system magnesium oxide-boric anhydride. N. A. Toropov and P. F. Kononov (*J. Phys. Chem. Russ.*, 1940, 14, 1103—1110).—Mixtures containing <1 MgO per 1 B_2O_3 form two layers below 1183°, and their cooling curves show an endothermal transformation at 1020° and an exothermal one at 780°. $MgO \cdot B_2O_3$ melts at 1191°, and $2MgO \cdot B_2O_3$ at 1381±5°; cooling curves of their mixtures indicate transformations at 1191° and 1020°. $3MgO \cdot B_2O_3$ melts at 1400±5° and forms eutectics at 1300±5° (B_2O_3 43.2 wt.-%) and 1360±

5° (B_2O_3 27.4 wt.-%). A short optical and X-ray description of $\text{MgO} \cdot \text{B}_2\text{O}_3$, $2\text{MgO} \cdot \text{B}_2\text{O}_3$, and $3\text{MgO} \cdot \text{B}_2\text{O}_3$ crystals is given. J. J. B.

Molecular compounds in the sulphonamide series.—See A., 1941, II, 339.

Ternary system pseudowollastonite-akermanite-gehlenite.—See A., 1941, I, 488.

Affinity between cadmium and zinc, and sulphur. I. A. Makolkin (*J. Phys. Chem. Russ.*, 1940, 14, 429–431).—The e.m.f. of the cells $\text{Pt}|\text{H}_2|0.01\text{N-KCl}|\text{H}_2\text{S}|\text{CdS}$ and $\text{Pt}|\text{H}_2|0.01\text{N-KCl}|\text{H}_2\text{S}|\text{ZnS}$ are 0.54754, 0.54452, 0.54149 v., and 0.84186, 0.83871, and 0.83554 v., at 15°, 25°, and 35°, respectively. From these vals. the free energy of the reaction solid $\text{Cd} + \text{rhombic S} \rightarrow \text{solid CdS}$ is calc. to be -32970 g.-cal. at 25°; the val. for ZnS is -46650 g.-cal. J. J. B.

Thermodynamics of the production of hydrocarbons from calcium carbide. R. Negishi, O. Kimura, and O. Kamiike (*Rev. Phys. Chem. Japan*, 1941, 15, 31–41).—The free energies of formation of various hydrocarbons at 100–500° are tabulated and the free energy changes associated with their production from CaC_2 , H_2 , and H_2O or CO are deduced. It is shown that in the presence of CaC_2 even those reactions which would be doubtful become thermodynamically possible. By the action of H_2O on CaC_2 in the absence of catalyst at 340° a dark reddish liquid, d 0.9–1.0, is produced in yield > that obtained by polymerisation of C_2H_2 in the presence of catalysts and absence of CaC_2 at lower temp. It is suggested that the ease of reaction of CaC_2 with H_2O and of the CaO formed with CO_2 should aid in accelerating org. syntheses in which H_2O and CO_2 are formed, without the necessity of displacing the equilibrium by raising the temp. J. W. S.

VII.—ELECTROCHEMISTRY:

Change of concentration in a solution by electrolysis. S. Kaneko (*Bull. Electrotech. Lab.*, 1940, 4, 676–678; *Rev. Phys. Chem. Japan*, 1941, 15, 66).—By extension of Sand's theory (A., 1901, ii, 82) the change of concn. near a plane or cylindrical electrode during electrolysis is considered. J. W. S.

Solution pressure of pure aluminium. II. I. Igarasi and S. Kodama (*Nippon Kinzoku Gakkai-Si*, 1939, 3, 428–430; *Rev. Phys. Chem. Japan*, 1941, 15, 64).—The effects of impurities on the solution pressure of Al have been investigated with special reference to the change with time, the addition of H_2 or O_2 , and the surface condition of the electrode. The electrode potential of 99.99% Al is ~ -1.22 v. whilst for both 99.8 and 99.5% Al it is ~ -0.82 v. J. W. S.

Mechanism of the action of the nickel oxide electrode. I. B. V. Erschler, G. S. Tiurikov, and A. D. Smirnova (*J. Phys. Chem. Russ.*, 1940, 14, 985–988).—It is usually assumed that charging of the $\text{Ni}(\text{OH})_2$ electrode involves liberation of H_2O , and discharging consumes H_2O from the electrolyte. To check this assumption a $\text{Ni}(\text{OH})_2$ electrode was charged in KOH ; the decrease of $[\text{KOH}]$ corresponded with 1.1–2.0 mol. of H_2O per faraday in 4.2N- and 2.3–3.6 H_2O in 1.5N- KOH . On a subsequent discharge an apparent consumption of 1.4–2.6 and 2.8–3.8 H_2O respectively per faraday took place. These effects were, however, only apparent since the concn. of K_2CO_3 or KCl added to KOH remained almost const. during charge and discharge. $[\text{KOH}]$ changes because of a sorption or desorption of KOH by $\text{Ni}(\text{OH})_2$. J. J. B.

Solvent effect on semiquinone redox equilibria. E. Burstein and A. W. Davidson (*Trans. Electrochem. Soc.*, 1941, 80, Preprint 13, 125–142).—The stability of semiquinones is dependent largely on the acidity of the medium in which they are formed, on the ϵ of the solvent, and on the ionic strength of the solution, whence it is concluded that the semiquinone ion is a stable entity, exhibiting the electrical properties of ordinary ions. It is suggested that since the effect of the solvent on the oxidation-reduction equilibrium depends on the nature of the charge of the reactants, the order of the normal oxidation-reduction potential should change with the solvent, just as the sequence of the strengths of a series of acids varies from one solvent to another. J. W. C.

Dependence of the capacity of a mercury electrode on the frequency of alternating current. T. Borisova and M. Proskurnin (*J. Phys. Chem. Russ.*, 1940, 14, 368–370).—The

capacity C of Hg in N-KCl was measured between 50 and 3500 cycles per sec. with amplitudes of 1 mv. Near the max. of the electrocapillary curve C is 48 μF . per sq. cm. for 50 and 32 for 3500 cycles, but the difference decreases to 0 when negative polarisation increases. Thon's results (cf. A., 1934, 493) are disproved. J. J. B.

Passivity of platinum. I. B. Erschler (*J. Phys. Chem. Russ.*, 1940, 14, 357–367).—A Pt electrode was polarised in 0.5N- HCl by a.c. of 50 cycles per sec., and a cathodic oscillograph arranged so as to show the potential of the electrode as a function of the electricity supplied to it, beginning with a cathodic or anodic half-period. The curves of potential against coulombs supplied are shifted to higher voltages when the electrode is also anodically polarised by a d.c.; this shift is at small charges > at high charges, and the potential V becomes independent of the a.c. when the d.c. is large enough. When the d.c. is small it is used up for dissolution of Pt as Pt^{++} ; at a higher d.c. Cl is liberated and transforms the Pt into a Cl electrode, which has a high capacity and is less affected by a.c. When the effect of the a.c. is reduced Pt becomes passive. Assuming the capacity of the double layer to be independent of V the rate of dissolution of Pt by the a.c. can be calc.; it appears to be independent of V between 1 and 1.2 v. (against N-H electrode). This is probably due to a blocking of the Pt surface by O_2 at higher V . The thickest O_2 covering observed was only 0.56 of a unimol. layer; therefore the rate of dissolution must increase very rapidly with the area of free Pt surface. J. J. B.

Passivity of metals. II. Periodical phenomena at the boundary iron-nitric acid solution. M. S. Golombik, N. N. Petin, and O. P. Juchnovskaja (*J. Phys. Chem. Russ.*, 1940, 14, 740–747; cf. A., 1939, I, 528).—Steel becomes passive in conc. HNO_3 without pulsation. Various samples of Fe give visible pulsations of various kinds. One sample (C 0.5, S 0.033, P 0.042%) pulsed for 22–26 sec. independently of the $[\text{HNO}_3]$; the time before the pulsations set in decreased from 500 to a few sec., and the frequency of pulsations increased from <1 to 88 per min. when $[\text{HNO}_3]$ rose from 6.8N. to 10N. When Fe is anodically or cathodically polarised in 7.5N- HNO_3 its rate of dissolution is lowered; during cathodic polarisation periodic changes of the electrode potential and of the c.d. take place, the c.d. increasing when the potential decreases. Passivation is due to undissociated HNO_3 , and dissolution of Fe to II^+ . Fe is passive in conc. HNO_3 since this contains a large proportion of HNO_3 mols. Pulsations and vibrations of potential and c.d. are caused by periodic formation and dissolution of an O_2 layer on the electrode. Cathodic polarisation retards the dissolution since Fe becomes covered with a protective H_2 layer. J. J. B.

Anodic behaviour of tin. IV. H. Itô (*Nippon Kinzoku Gakkai-Si*, 1940, 4, 393–396; *Rev. Phys. Chem. Japan*, 1941, 15, 65–66).—The presence of 0.5% of Sb does not appreciably affect the anodic behaviour of Sn but 5% rapidly causes passivity. When the potential on the passive anode is increased to a certain val. a second passivity phenomenon is observed which is attributed to the formation of basic Sb sulphate in the pores of the metal. J. W. S.

Anodic behaviour of Cu_3Sn_2 . H. Itô (*Tech. Rep. Kyushu Imp. Univ.*, 1940, 15, 114–118; *Rev. Phys. Chem. Japan*, 1941, 15, 66).—In H_2SO_4 a Cu_3Sn_2 anode remains active for a short time and then suddenly becomes passive. On raising the voltage O_2 begins to be liberated at an anode potential of +2.3–2.4 v. No dissolution of Cu is detectable. In HCl periodic dissolution of the anode is observed. The decomp. of Cu_3Sn_2 , followed by dissolution of Cu, is forced by the high anode potential in the passive periods; then the anode becomes active and insol. Cu_2Cl_2 deposits on its surface, making it passive again. J. W. S.

Structure of electrodeposited metals as a function of the rate of passivation. I. Number of crystals formed at electrodeposition of silver. N. T. Vagramjan (*J. Phys. Chem. Russ.*, 1940, 14, 1132–1138).—The no. of Ag crystals formed on an Ag cathode in 1.1N- AgNO_3 increases when the overvoltage decreases, e.g., at a higher temp. (60°) or a lower c.d. (0.024 amp. per sq. cm.). Dextrin and BzOH increase the overvoltage and lower the no. of crystals. J. J. B.

Electrode polarisation. III. Theoretical implications of the rate of growth of polarisation potentials. A. Hickling

(*Trans. Faraday Soc.*, 1941, **37**, 532—535; cf. A., 1940, I, 165).—In the growth of a polarisation potential due to the accumulation at the electrode of an active product, the relation between potential and the quantity of electricity passed must depend on (a) the quantity of electricity used in setting up a concn. of active material at the electrode surface and (b) the quantity used in setting up the corresponding double layer, and may vary from approx. linear to approx. logarithmic according to the relative magnitude of these two factors. Calculation shows that in the case of H overvoltage the relation should be linear. The observed linear relation between quantity and potential is therefore not inconsistent with the at. H theory. A similar linear relation is to be expected in many other cases in which overvoltage is due to accumulation of an active product. F. L. U.

Discharge of zinc ions at the dropping mercury cathode, a test of the Ilkovic equation. A. Walkley (*J. Amer. Chem. Soc.*, 1941, **63**, 2278—2279).—The relation between $[Zn]$ in the basal solution 0.1M-NH₄Cl, 0.02M-KCNS, and 0.0002% methyl-red, and the limiting current (i_l) has been investigated at 20° using the dropping Hg electrode. For $[Zn]$ 0.05 to 5.00 m-mols. per l. $i_l/[Zn]$ is const. and in good agreement with the val. calc. from the Ilkovic equation. W. R. A.

Application of the Ilkovic equation to the analysis of mixtures of reducible substances with the dropping mercury electrode. I. M. Kolthoff and E. F. Orlemann (*J. Amer. Chem. Soc.*, 1941, **63**, 2085—2088).—For mixtures of two electro-reducible substances, the diffusion current (i_0) of the second constituent is obtained by subtracting from the total current the val. i_a of the first diffusion current at the potential at which the total current is measured. i_a is evaluated by application of the Ilkovic equation. i_0 for Mn has been computed from current-voltage curves of mixtures of 10⁻³M-CuSO₄ and 10⁻³M-MnSO₄ in the presence of 0.1M-KCl and 0.008% gelatin measured by the dropping Hg electrode at 25°. W. R. A.

Oscillographic study of the polarisation of metal electrodes. III. Copper and nickel electrodes. V. A. Juza and L. D. Kopil (*J. Phys. Chem. Russ.*, 1940, **14**, 1074—1084).—Both cathodic and anodic polarisation of Cu in acidified CuSO₄ solution as a function of time can be accounted for by the theory of retarded discharge. The decay (but not the development) of polarisation of Ni in NiCl₂ solution containing boric acid is also in agreement with the theory. The calc. rate of ionisation at the equilibrium potential is $\sim 10^{-10}$ g.-ion per sq. cm. per sec. for Cu (i.e., similar to Zn), and $\sim 10^{-13}$ — 10^{-14} for Ni (similar to Fe). Gelatin increases the polarisation of Cu, and lowers the capacity of the Cu electrode and the rate of ionisation. In acidified solutions of NiSO₄ Ni is a H electrode. J. J. B.

Moving boundary electrophoretic study of insulin.—See A., 1941, III, 921.

VIII.—REACTIONS.

Condition of applicability of Bodenstein's method in chemical kinetics. D. A. Frank-Kamenetzki (*J. Phys. Chem. Russ.*, 1940, **14**, 695—700).—The method of quasi-stationary concns. of intermediate products can always be applied when the life of the intermediate product concerned is \ll the "characteristic time" of the concn. change of other components the concn. of which is not quasi-stationary. There are two additional conditions of applicability of Bodenstein's method but they are practically always fulfilled. J. J. B.

Oxidation of hydrogen by atomic oxygen. M. M. Pavliutshenko (*J. Phys. Chem. Russ.*, 1940, **14**, 877—885).—The pressure of O₂-H₂ mixtures irradiated by ultra-violet light decreases because of the H₂O formation. The rate v of reaction increases with the pressure of O₂ (0.015—0.1 mm. Hg) and H₂ (0.02—0.08 mm. Hg) and α the intensity of light. It is not affected by H₂O or Hg vapour and, therefore, the reaction must be taking place in space. At a const. concn. (as distinct from pressure) v has identical vals. at room temp. and in liquid air, showing the absence of an activation energy. In a Ag vessel v is only slightly $>$ in quartz. In a mixture of CO, H₂, and O₂ the metastable O atoms are distributed between CO and H₂; CO does not stop the oxidation of H₂, confirming that the reaction occurs in space. Metastable O is also used up in collisions with O₂ mols. In a platinised

vessel oxidation of H₂ takes place on the walls as well, and v may be twice as large as in quartz. J. J. B.

Explosive reactions of gases. I. Explosion limits of oxygen-hydrogen mixtures. S. Kimata, N. Aomi, and R. Gotô (*Rev. Phys. Chem. Japan*, 1941, **15**, 42—53).—The presence of H₂O vapour retards the explosive reaction of 2H₂ + O₂ mixtures, and hence it is inferred that the variation of the upper explosion limit according to the pre-treatment of the Pyrex reaction vessel and to the rate of heating is due to differences in the amount of H₂O initially present or formed by surface reaction. Variations of the explosion limit with rate of decrease of pressure and diameter of tube are attributed to a turbulence of the gas affecting the rate of surface reaction. The effect of metals in narrowing the explosion limits is attributed to the formation of H₂O by surface reaction. The retarding action of salts is also attributed to a modification of the surface reaction. J. W. S.

Chain reactions of ozone in aqueous solution. Interaction of ozone and formic acid in aqueous solution. H. Taube (*J. Amer. Chem. Soc.*, 1941, **63**, 2453—2458; cf. A., 1941, I, 118).—The rate of reduction of O₃ by HCO₂H and the rate of the accompanying decomp. of O₃ have been determined at 0° at varying concns. of O₃, HCO₂H, HClO₄, and of the inhibitors Cl⁻ and AcOH. Both are chain reactions. The chain-initiating step is reaction of O₃ with HCO₂⁻ forming HO-HO₂ chains which decompose O₃. The limiting val. of the sp. rate of reduction at high inhibitor concn. is not equal to the sp. rate of chain initiation but includes the sp. rate of an additional path for the former. Over a ten-fold range of $[H^+]$ the rate of reaction of HO with AcOH was independent of $[H^+]$, whilst that with Cl⁻ varied linearly with $[H^+]$. The rate of reaction of $[H^+]$ with Cl⁻ is \gg with AcOH, in agreement with existent data. In absence of inhibitor at high $[HCO_2H]$ the chains are broken by reaction of HO and HCO₂H. The relative sp. rate of reaction of HO with O₃ and HCO₂H is 11 in 0.104M-H⁺. W. R. A.

Kinetics of the slow oxidation of hydrogen sulphide. N. M. Emanuel (*J. Phys. Chem. Russ.*, 1940, **14**, 863—876).—The reaction between H₂S and O₂ (1 : 1.5—4) was studied between 210° and 350° at 50—250 mm. Hg; the pressure p of the reacting gas was recorded continuously. p first remained const. (induction period) for τ sec. or, when $[O_2] : [H_2S]$ was high, slightly increased, and then decreased. If p_0 is the initial pressure $d\tau p_0^{1/3} \exp(-20,000/RT) = \text{const.}$, d being the diameter of the vessel (2—4 cm.). After the induction period the rate of reaction gradually rose to a max. which was reached when 10—15% of H₂S was consumed. During this period the % H₂S consumed $\propto p_0^{0.4}$, t being the time, and $\theta \propto p_0^{1/3} \exp(-20,000/RT)$; θ was the greater the higher was $[O_2]$. In the third stage, beyond the max. of the reaction rate, the rate $\propto d$; the activation energy was 18,000 g.-cal. N₂ and SO₂ had no effect. S vapour extended τ ; 0.5—1 mm. Hg of S precluded the reaction altogether. When S was added during the third stage it had no effect. Cl₂ acted like S, presumably because of the reaction H₂S + Cl₂ = 2HCl + S. The mechanism of the reaction remains unknown. J. J. B.

After-burning of carbon monoxide. Spectroscopic evidence for abnormal dissociation. A. G. Gaydon (*Nature*, 1941, **148**, 226).—The theory of the later stages of the combustion of CO is summarised; it explains many of the peculiarities of the combustion of CO, such as the effect of H₂O on flame speed and temp., the effect of drying in increasing the infra-red radiation from explosions, and the failure to observe the infra-red band at 14.9 μ . L. S. T.

Explosion reactions. Reaction between carbon monoxide and oxygen. I. W. Jono (*Rev. Phys. Chem. Japan*, 1941, **15**, 17—30).—The author's method (*ibid.*, 1935, **9**, 1) has been applied to the study of the reaction between CO and O₂. There is no discontinuous jump between the regions of non-explosive and explosive reaction and it is inferred that under isothermal conditions the reaction follows the same mechanism in both regions. Sudden mixing of the gases can produce explosion below the normal explosion temp. and pressure, an effect which can be attributed either to the absence of retardation by reaction products or to the promotion of deactivation by intermediate products. The lower explosion limit is assumed to be conditioned by the action of the vessel

wall whilst the upper limit is produced by the mutual destruction of the intermediate products (ions or radicals).

Distribution of the CS radical in the low-temperature flame of carbon disulphide. V. Kondratev (*J. Phys. Chem. Russ.*, 1940, 14, 287—290).—The flame of CS_2 - O_2 mixtures is greyish-green and contains CS when $[\text{O}_2] : [\text{CS}_2] = r$ is < 2.5 ; it is bluish-violet and free from CS at higher r . In the flame of mixtures with r slightly < 2.5 at < 4 mm. Hg the [CS] is max. below the middle of the flame but is considerable also at its tip. At r slightly > 2.5 [CS] is high at the base of the flame but no CS is present in its upper half. The zone of detectable [CS] is $>$ that of the green coloration of the flame because of the diffusion of CS mols. [CS] is max. in the brightest zone of the flame. CS has a chemical, not a thermal, origin. At $r = 2.5$ the mechanism of the combustion changes. [CS] was determined by comparing the absorption by the flame of the radiations 2575.6—2576.7 \AA , which is, and 2589.7—2592.1 \AA , which is not, absorbed by CS. J. J. B.

Spectroscopic study of carbonyl sulphide flame. D. Pavlov (*J. Phys. Chem. Russ.*, 1940, 14, 601—604).—Mixtures of COS and O_2 burnt at 5—200 mm. Hg. When $r = [\text{O}_2] : [\text{COS}]$ was > 1.1 the reaction was $\text{COS} + 1.1\text{O}_2 \rightarrow 0.8\text{CO} + 0.2\text{CO}_2 + \text{SO}_2$. At $r < 0.5$ the combustion gases contained S. The emission spectrum of the flame was like that of the CS_2 flame; the bands of S_2 showed that the bond C—S was severed preferentially to C—O. The absorption spectrum contained, in addition to SO_2 bands, those of CS, showing that the bond C—O was also broken. When COS was kept at 365°, SO_2 and C were detected. J. J. B.

NH, the primary product of explosive oxidation of ammonia. N. V. Tokarev (*J. Phys. Chem. Russ.*, 1940, 14, 642—643).—Mixtures of NH_3 (20—67%) and O_2 at 250° and 150 mm. Hg were ignited by a spark. In the spectrum of the flame the band 3360 \AA . of NH was observed; hence, NH and not HNO is the primary product of NH_3 oxidation. J. J. B.

Thermal decomposition of ethylidene bromide. P. T. Bennett and A. Maccoll (*J. Proc. Roy. Soc. N. S. Wales*, 1940, 74, 527—537).—The thermal dissociation of gaseous $\text{C}_2\text{H}_4\text{Br}_2$ into $\text{C}_2\text{H}_3\text{Br}$ and HBr is a first-order reaction with an activation energy of 40.9 kg.-cal. Over the range 340—400° the velocity coeff. (in sec^{-1}) can be represented by $\ln k = 25.75 - 40,900/RT$. The reaction possibly proceeds by way of an activated complex of the form

$$\begin{array}{c} \text{CH}_2 \cdots \text{H} \\ | \quad | \\ \text{CHBr} \cdots \text{Br} \end{array}$$

C. R. H.

Combustion of glycol nitrate. A. F. Beliaev (*J. Phys. Chem. Russ.*, 1940, 14, 1009—1025).—Beliaev's theory (cf. B., 1938, 735) that combustion of explosives takes place in the gas phase and is preceded by evaporation of the explosive is applied to $(\text{CH}_2\text{O}\cdot\text{NO}_2)_2$ (I). When (I) is ignited in a beaker there is a dark layer between the liquid surface and the flame above it; the flame consists of two parts, the upper part disappearing in N_2 . In the lower part the decomp. (I) = $2\text{NO} + 1.7\text{CO} + 1.7\text{H}_2\text{O} + 0.3\text{CO}_2 + 0.3\text{H}_2$ occurs; NO , CO , and H_2 are oxidised in the upper part. The v.p. of (I) between 74° and 198° is given by $\log p = 9.73 - 3200/T$, where p = mm. Hg. The rate of decomp. ("combustion") of (I) increases from 0.29 mm. per sec. when the liquid is ignited at 20° to 0.63 mm. per sec. when it is at 183°; at higher temp. the rate increases to detonation because of the stirring of the liquid by bubbles of the decomp. products and of the boiling (I). The rate of decomp. is calc. according to laws of gaseous reactions; both from the abs. rate of reaction and from the temp. coeff. The activation energy of 35 kg.-cal. per mol. is obtained. The usual theory of explosion does not account for the observed rate of decomp. J. J. B.

Bond energies and repulsion energies in proton transfer reactions. R. P. Bell (*Trans. Faraday Soc.*, 1941, 37, 493—496; cf. A., 1940, I, 416).—Activation energies for the reaction $\text{CH} + \text{C}^- \rightarrow \text{C}^- + \text{CH}$ are obtained by means of intersecting energy curves. The interaction energy is calc. with two different vals. of r_0/p and two different vals. of r_0 (distance of closest approach), and in every case the bond energy constitutes the major part of the activation energy. Previous treatments of proton transfer reactions, in which the interaction energy has been ignored, are therefore probably substantially correct. The calc. activation energies all fall within

the range 12—25 kg.-cal. per mol., in agreement with experiments on reactions catalysed by acids and bases. F. L. U.

Kinetics of the decomposition of the fluorosilicate ion by alkali. I. G. Riss and M. M. Slutzkaja (*J. Phys. Chem. Russ.*, 1940, 14, 701—707).—0.2—0.02M. solutions of Na_2SiF_6 were mixed with $<$ the equiv. amount of NaOH and a drop of phenolphthalein, and the time required for the colour change was noted. The reaction is of the first order; the rate-determining process is presumably $\text{SiF}_6^{--} \rightarrow \text{SiF}_4 + 2\text{F}^-$. For the reaction coeff. between 10° and 50° the equation $\log k = 13.033 - 4248/T$ holds (time in sec.). The % of decomp. of SiF_6 in a 38-day-old solution at 20° is 92%. J. J. B.

Exchange reaction between chloride ion and *tert*-butyl chloride. W. Koskoski, H. Thomas, and R. D. Fowler (*J. Amer. Chem. Soc.*, 1941, 63, 2451—2453).—The exchange reaction between Cl^- and Bu^tCl , studied in HCO_2H at 15°, proceeded through the equilibrium established between Bu^tCl , *iso*- C_4H_9 , and Cl^- . Bimol. collision between Bu^tCl and Cl^- does not affect the reaction. The rate coeff. for ionisation is $3 \times 10^{-4} \text{ sec}^{-1}$ in good agreement with existing data (cf. A., 1937, I, 467) for hydrolysis of Bu^tCl under similar conditions. W. R. A.

Interaction of cyclohexanol and hydrogen chloride. A. G. Gassmann and R. J. Hartman (*J. Amer. Chem. Soc.*, 1941, 63, 2139).—The rate of esterification of anhyd. cyclohexanol (I) by anhyd. HCl (conc. $\sim 0.1\text{N}$) is determined at 60°, 80°, 90°, 100°, and 110°. The energy of activation is 27,100 g.-cal. There is no reaction at 60° and only 15% after 120 hr. at 80°. There is thus no significant interference when HCl is used with org. acids and (I) at 75° (A., 1939, I, 529). R. S. C.

Kinetics of bromide- α -bromopropionic acid exchange in aqueous solution. W. Koskoski, R. W. Dodson, and R. O. Fowler (*J. Amer. Chem. Soc.*, 1941, 63, 2149—2152).—The rate of exchange of radioactive Br^- with aq. $\text{CHMeBr}\cdot\text{CO}_2\text{H}$ in presence of 1.014N- H_2SO_4 has been studied at 60°, 70°, 80°, and 100°. The reaction obeys the Arrhenius equation and the effective collision diameter and activation energy are respectively 1.3 \AA . and 20.9 kg.-cal., in agreement with existing data. W. R. A.

Esterification kinetics of disubstituted benzoic acids in methyl alcohol. A. G. Gassmann and R. J. Hartman (*J. Amer. Chem. Soc.*, 1941, 63, 2393—2395).—Velocities of esterification (V) of 2:4-, 2:5-, and 3:5- $\text{C}_6\text{H}_3\text{Cl}_2\text{CO}_2\text{H}$ and of 3:5-(NO_2) $_2\text{C}_6\text{H}_3\text{CO}_2\text{H}$ by MeOH have been determined at 30°, 40°, 50°, and 60°, and activation energies computed. V is affected by the P factor of the Arrhenius equation and by E . W. R. A.

Effect of structure on reactivity of carbonyl compounds; temperature coefficients of rate of formation of semicarbazones. F. P. Price, jun., and L. P. Hammett (*J. Amer. Chem. Soc.*, 1941, 63, 2387—2393).—The rates (k) of formation of the semicarbazones of COMe_2 , COEt_2 , pinacolone (I), cyclopentanone (II) and -hexanone (III), furfuraldehyde (IV), and COPhMe have been studied in a phosphate buffer of p_H 7.0, by I titration at $\sim 25^\circ$ and at $\sim 0^\circ$, for use in which a new type of thermostat with an accuracy of $\pm 0.002^\circ$ is described. The transition state is regarded as carbonyl compound, semicarbazide, and H_2PO_4^- . The potential energy barriers for COMe_2 , COEt_2 , and (I) are of approx. the same height and the 90-fold variation in k is essentially an entropy effect, the same considerations applying to the 30-fold difference in k between COPhMe and (IV). With COMe_2 , (II), and (III) the difference in barrier height is ~ 2000 g.-cal., which is not explainable, whilst a similar difference between COMe_2 and COPhMe is attributed to resonance stabilisation in COPhMe . For all compounds studied the entropy of activation increases with increasing rigidity of structure, and the increase is attributed to the transition state possessing a relatively rigid structure. W. R. A.

Activated complex theory applied to fast reactions. Reaction of aldichloroimines with bases. W. E. Jordan, H. E. Dyas, and D. G. Hill (*J. Amer. Chem. Soc.*, 1941, 63, 2383—2387).—The variation with temp. of the rates of reaction of $p\text{-C}_6\text{H}_4\text{Cl}\cdot\text{CH}\cdot\text{NCl}$ (I) and $p\text{-OMe-C}_6\text{H}_4\cdot\text{CH}\cdot\text{NCl}$ with NaOEt and NaOMe in EtOH and MeOH respectively and of (I) with NEt_3 in MeOH and in C_6H_6 has been studied over the temp. range 0° to 40°. The results are interpreted from (i) the collision and (ii) the activated complex theory and vals. of E , PZ , ΔG , and ΔS are tabulated. The application of (ii) in

contrast to (i) permits several correlations with other existent data.

W. R. A.

Chlorophyll-phæophytin. Temperature coefficient of rate of phæophytin formation. G. Mackinney and M. A. Joslyn (*J. Amer. Chem. Soc.*, 1941, **63**, 2530—2531).—Rate coeffs. (*k*) of the first-order reaction of chlorophyll *a* (I) and chlorophyll *b* (II) with 0.002—0.05N- $\text{H}_2\text{C}_2\text{O}_4$ in aq. COMe_2 over the temp. range 273—324° K. have been determined. $\log_e k/x$ varies linearly with $1/T$ except at the higher temp. *k* for (I) is $> k$ for (II), which is attributed to steric hindrance in (II). Activation energies of (I) and (II) are approx. equal. The stability of the Mg in chlorophyll is briefly discussed.

W. R. A.

Dielectric and solvent effects on the rate of sucrose inversion by hydrochloric acid. E. S. Anis and F. C. Holmes (*J. Amer. Chem. Soc.*, 1941, **63**, 2231—2235).—Dielectric and solvent effects on the rate of inversion of sucrose by HCl in the isocomposition and isodielectric media $\text{EtOH}-\text{H}_2\text{O}$ (I) and dioxan- H_2O (II) at 21°, 31°, and 41° have been investigated and developed theoretically. Rate and energy phenomena in (I) are explained qualitatively by assuming the formation of EtOH_2^+ , and not by a reaction between a dipole and a negative ion. The influence of dielectric const. on the inversion rate and activation energy for (II) is accounted for electrostatically. The theoretical considerations are applied to existing data on bromophenol-blue ion and OH^- , and NH_4^+ and CNO^- in mixed solvents and calc. vals. of the difference in activation energies in isocomposition and isodielectric media are in agreement with observed differences corr. for electrostatic energy.

W. R. A.

Kinetics of starch hydrolysis by pancreatic amylase.—See A., 1941, III, 923.

Rate and mechanism in reactions of ethyl *p*-toluenesulphonate with water, hydroxyl ions, and various halide ions. H. R. McCleary and L. P. Hammett (*J. Amer. Chem. Soc.*, 1941, **63**, 2254—2262).—The rates (*k*₁) of solvolytic reactions of *p*- $\text{C}_6\text{H}_4\text{MeSO}_3\text{Et}$ (I), EtCl , EtBr , and EtI and the rates (*k*₂) of displacement of $\text{C}_6\text{H}_4\text{MeSO}_3^-$ (II) by I^- , Cl^- , Br^- , and OH^- have been measured in 60–72% aq. dioxan at 50°. *k*₁ decreases in the order (I) $> \text{EtI} > \text{EtBr} > \text{EtCl}$ whilst *k*₂ decreases in the order $\text{I}^- > \text{OH}^- > \text{Br}^- > \text{Cl}^-$. The behaviour of EtI and I^- and (II) is attributed to the lower solvation energy of I^- compensating approx. for its weaker binding to C. Equilibrium consts. for I^- and Br^- are $\sim 10^2$. Halide ions decrease the rate of formation of EtOH from (I) consistently with an ionic mechanism of solvolysis.

W. R. A.

Dynamics of oxidation of 2-methylantraquinone and derivatives by chromic acid.—See A., 1941, II, 369.

Kinetics of reactions in non-aqueous solutions. N. K. Vorobiev (*J. Phys. Chem. Russ.*, 1940, **14**, 686—694).—Equilibrium between quaternary NH_4^+ salts, *tert.* amines, and $\text{CH}_2=\text{CH}-\text{CH}_2\text{Br}$ (I) is determined at 38–51° in 0.1–0.2M. solution. The highest concn. of salt is observed for *m*- $\text{C}_6\text{H}_4\text{Cl}-\text{NMe}_2\text{Br}-\text{C}_6\text{H}_5$ (II) in MeOH , and the order is *p*- $\text{C}_6\text{H}_4\text{Me}-\text{NMe}_2\text{Br}-\text{C}_6\text{H}_5$ in $\text{PhNO}_2 > \text{NPhMe}_2-\text{Br}-\text{C}_6\text{H}_5$ (III) in $\text{CHCl}_3 > \text{(III)}$ in $\text{PhNO}_2 > \text{(III)}$ in $\text{COMe}_2 > \text{m}-\text{C}_6\text{H}_4\text{Me}-\text{NMe}_2\text{Br}-\text{C}_6\text{H}_5$ in $\text{PhNO}_2 > \text{(III)}$ in $\text{COPhMe} > \text{(II)}$ in PhNO_2 . The velocity coeffs. of the reactions $\text{C}_6\text{H}_5\text{N} + \text{(I)} \rightarrow \text{C}_6\text{H}_5\text{NBr}-\text{C}_6\text{H}_5$ and $\text{NPhMe}_2 + \text{(I)} \rightarrow \text{(III)}$ in CHCl_3 increased in the course of one experiment because of the accelerating effect of the NH_4^+ salt; the activation energies of these reactions are 12,300 and 9100 g.-cal., respectively. Reaction consts. and activation energies are also given for the formation and decomp. of (III) in PhNO_2 , COMe_2 , and COPhMe , and of *m*- and *p*- $\text{C}_6\text{H}_4\text{Me}-\text{NMe}_2\text{Br}-\text{C}_6\text{H}_5$ in PhNO_2 . These and earlier results show that the rate of formation of NH_4^+ salts increases in the order $\text{COMe}_2 < \text{CHCl}_3 < \text{COPhMe} < \text{PhNO}_2$, and the rate of decomp. in the order $\text{CHCl}_3 < \text{COMe}_2 < \text{PhNO}_2 < \text{COPhMe}$. The pre-exponential factor in the Arrhenius equation is 10^2 – 10^4 for the rate of formation, and 10^{11} – 10^{16} for the rate of decomp.

J. J. B.

Reduction of carbon dioxide by carbon. A. F. Semetschkova and D. A. Frank-Kamenetzki (*J. Phys. Chem. Russ.*, 1940, **14**, 291—304).—When coke or sugar C is heated with CO_2 at 50–200 mm. Hg the gas pressure, after a small fall due to an adsorption of CO_2 , remains const. at 600° since half of the CO formed is adsorbed by C; at 770° the pressure increases slowly, and at 900° rapidly since 2 CO are liberated for 1 CO_2 consumed. The reaction $\text{CO}_2 + \text{C} = \text{CO} + \text{adsorbed CO}$ has an activation

energy of 27 kg.-cal. for coke, C, or $\text{C} + \text{Al}_2\text{O}_3$ or $+ \text{Fe}_2\text{O}_3$. For the activation energy of the desorption of CO vals. of 23–63 kg.-cal. are obtained.

J. J. B.

Kinetics of the growth of microcrystalline particles from supersaturated solutions. S. Tscherdincev (*Acta Physicochim. U.R.S.S.*, 1941, **14**, 337—352).—Theoretical. The relationship between the size-distribution of microcryst. particles growing in a supersaturated solution and the velocity of their growth is considered. Comparison with observation in the case of growing photographic emulsions is satisfactory.

F. J. G.

Sputtering of platinum in hydrogen and deuterium. R. W. Ditchburn and K. I. Roulston (*Proc. Camb. Phil. Soc.*, 1941, **37**, 438—439).—The rates of sputtering, measured by the optical density of the deposit produced in a given time, of Pt in H_2 and D_2 have been compared, using ions drawn from a low-voltage arc and accelerated through a known potential. The rates are the same within a few %.

O. D. S.

Theory of thermal explosion. III. Thermal explosion resulting from autocatalytic reactions. O. M. Todes and P. V. Melentiev (*J. Phys. Chem. Russ.*, 1940, **14**, 1026—1042).—An extensive survey of theory of the kinetics of reactions terminating in an explosion is given.

J. J. B.

Effect of catalysts on decomposition of organic peroxides. I. Decomposition of ethyl peroxide and benzoyl peroxide. F. I. Berezovskaja and E. K. Varfolomeeva (*J. Phys. Chem. Russ.*, 1940, **14**, 936—940).—The peroxides decompose at 80–100° in a unimol. reaction. The reaction coeff. *k* (sec^{-1}) at 100° is 0.0003, and the activation energy 20,500 g.-cal. Substances retarding the autoxidation of hydrocarbons ($\alpha\text{-C}_{10}\text{H}_7\text{-OH}$, $\text{NHPh-C}_{10}\text{H}_7\text{-}\beta$, *p*- $\text{NHPh-C}_6\text{H}_4\text{-OH}$, triphenylthiophosphine, and $\alpha\text{-C}_{10}\text{H}_7\text{-NH}_2$) have no definite effect on *k*, but quinol (1 mol. per 20 mols. of peroxide) stops the decomp. of Et_2O_2 . Mn naphthenate which accelerates the autoxidation of hydrocarbons retards the decomp. of (I) but is inactive towards Bz_2O_2 . Anti-knock compounds (PbEt_2 and NH_2Ph) increase *k* 2–10 times. Substances promoting knocking have no effect; only PhCHO increases *k* of Bz_2O_2 . Since peroxides are intermediate products of hydrocarbon oxidation it was expected that catalysts would affect the decomp. of peroxides as they do the oxidation, but no correlation between these effects was detected. Presumably catalysts influence the formation of peroxides.

J. J. B.

Rate and mechanism of hydrolysis of hydroxylaminedisulphonate ion. S. Naiditch and D. M. Yost (*J. Amer. Chem. Soc.*, 1941, **63**, 2123—2127).—Pure anhyd. $\text{OH}\cdot\text{N}(\text{SO}_3\text{K})_2$ has been prepared and kept for more than a month without appreciable decomp. The rate of hydrolysis of $\text{OH}\cdot\text{N}(\text{SO}_3)_2^-$ has been investigated in H_2O and in dil. HCl at 25°, 45°, and 55°. The hydrolysis is catalysed by H_2O and HCl, the effect of HCl being \gg that of H_2O . For acid solutions the rate equation is $-\text{d}[\text{OH}\cdot\text{N}(\text{SO}_3)_2^-]/\text{dt} = k[\text{H}^+][\text{OH}\cdot\text{N}(\text{SO}_3)_2^-]$. The acid-catalysed hydrolysis is explained by assuming the formation of $\text{OH}\cdot\text{N}(\text{SO}_3)_2\text{H}_2\text{O}$ as an intermediate, the rate of decomp. of which determines the over-all rate of hydrolysis. The effect of temp. on *k* corresponds with an activation energy of 17,600 g.-cal. per mol.

W. R. A.

Catalytic oxidation-reduction of metallic complex salts. XII. Reduction of benzoquinone by hydrogen in presence of $[\text{Pd en}]_2\text{Cl}_2$. Y. Shibata and E. Matsumoto (*J. Chem. Soc. Japan*, 1939, **60**, 1173—1176; *Rev. Phys. Chem. Japan*, 1941, **15**, 66).—Addition of $[\text{Pd en}]_2\text{Cl}_2$ ($\text{en} = (\text{CH}_2\text{-NH}_2)_2$) to benzoquinone accelerates its reduction by H_2 in the dark.

J. W. S.

Amperometric measurements of potency of catalase.—See A., 1941, III, 795.

Thermal analysis of the catalytic action of colloids. II. Effect of temperature and heat-treatment of platinum sol on the catalytic decomposition of hydrogen peroxide by colloidal platinum. E. Suito (*Rev. Phys. Chem. Japan*, 1941, **15**, 1—16; cf. *ibid.*, 1939, **13**, 74).—The velocity of catalytic decomp. of H_2O_2 by Pt sol has been studied at 25–60° by measurement of the temp. rise produced by the reaction. The reaction is of the first order at $> 45^\circ$ and a max. velocity of reaction occurs at $\sim 55^\circ$. Heating at 80° or 95° decreases the activity of the sol but boiling increases its activity. On freezing it coagulates and its activity is decreased. After the sol has been boiled or frozen the initial induction period disappears and the whole reaction is of the first order. This induction period is attri-

buted to the presence of O combined with the Pt surface, this film being removed on boiling or freezing. J. W. S.

Dissociation of hydrogen on tungsten and thorium-coated tungsten. N. S. Zaitzev (*J. Phys. Chem. Russ.*, 1940, 14, 644—649).—The rate v of dissociation was determined by the reduction of pressure p of H_2 cooled in liquid air after being in contact with hot W wire. In the course of one experiment $v \propto p$, i.e., the reaction is of the first order. At a const. p (10^{-3} – 10^{-2} mm. Hg) v is the higher the smaller is [Th] on the surface of W. Probability of dissociation is a linear function of the work function of the metal and is independent of temp. (1570—1820° K.). J. J. B.

Catalysis of the parahydrogen conversion by tungsten. D. D. Eley and E. K. Rideal (*Proc. Roy. Soc.*, 1941, A, 178, 429—451).—The conversion was measured on a W surface as a function of the surface concn. of adsorbed O_2 , acting as a poison. It appears that the O not only diminishes the surface available for reaction but also influences the reactivity of the neighbouring chemisorbed H. Films of CO, N_2 , and C_2H_4 also act as poisons; the evidence suggests that the small conversion that takes place in their presence proceeds by the formation of a hydride layer on top of the film rather than on gaps in it. The vals. of the conversion rate k were determined at a no. of temp. and the activation energy E and const. A were derived for a relation $k = A \exp(-E/RT)$. The variation of k with pressure of H_2 was investigated. The bearing of the results on the mechanism of the conversion is discussed. G. D. P.

Theory of formation of catalytically active ensembles on surfaces. III. Catalytic properties of iron on charcoal and asbestos supports used for ammonia synthesis. L. L. Klijatschko-Gurvitsch and N. I. Kobosev (*J. Phys. Chem. Russ.*, 1940, 14, 650—662).—Catalytic activity of a substance depends chiefly on its chemical composition, whilst its mode of prep. is of little importance. Fe catalysts produced by reduction of Fe_2O_3 , or by heating charcoal or asbestos soaked in $Fe(CO)_5$, have similar efficiencies if the percentage p of Fe in the mixed catalysts is high enough. The efficiency $k = xv$, where x is the $[NH_3]$ in the outgoing gas and v its rate of flow. k increases with p , and k/p passes through a max. which for charcoal lies at $p = 0.006$, 0.055, and 0.55 for 450°, 400°, and 350°, and for asbestos at $p = 0.7$ for 400° and 450°. k/p for charcoal is $>$ for asbestos because of the high surface area of charcoal. When the catalyst is kept at 500°, k decreases, and the rate of decrease is virtually the same for Fe without support, on charcoal, and on asbestos, showing that the "active ensembles" are identical in all three types. If the N_2 – H_2 mixture contains γ wt.-% of O_2 , xv is const., and the vals. of the const. for pure Fe and Fe on charcoal are almost identical. J. J. B.

Effect of water vapour on the rate of reduction of magnetite and haematite by carbon monoxide. E. P. Taticvskaja (*J. Phys. Chem. Russ.*, 1940, 14, 349—356).—2.5–20% of H_2O vapour added to CO strongly retards the reduction of Fe_3O_4 at 900° and especially at 500°; the retardation is more pronounced if the Fe_3O_4 was already partly reduced. Reduction of Fe_2O_3 is not affected by H_2O at 500° or 900° unless Fe_2O_3 is already partly reduced. H_2O has no sp. effect, it gives with CO on Fe oxide catalysts CO_2 and H_2 , and its apparent action is due to CO_2 . CO_2 does not retard the reduction of Fe_3O_4 to Fe_2O_3 . The inhibition of the reduction of Fe_3O_4 can be accounted for by considering the competition between CO and CO_2 for the magnetite surface. J. J. B.

Kinetics of the catalytic reduction of carbon monoxide by hydrogen to hydrocarbons on a cobalt-thorium catalyst. B. V. Jerosev, A. P. Runtzo, and A. A. Volkova (*Acta Physicochim. U.R.S.S.*, 1940, 13, 111—122).—The kinetics of the synthesis of hydrocarbons from CO and H_2 have been studied at 200° using a Co-Th catalyst on SiO_2 prepared by hydrolysis of $Si(OEt)_4$. The results are expressed by the following equations: (1) $\pi = Au_0 = au_0 + b$; (2) $u_k = \frac{cu_0 - b}{a}$; where π is the efficiency of the catalyst, A the contraction, u_0 and u_k the velocities of the gas streams entering and leaving the reaction vessel, and a , b , and c are consts. The form of equation (1) indicates that the catalytically active surface is of two kinds: on the first the reaction proceeds as one of zero order, whereas the second is only partly available to reactants, being partly covered with adsorbed products,

so that here the reaction velocity depends on the partial pressure of the products. F. J. G.

Reactions of nitric oxide and oxygen at low pressures and low temperatures. I—IV. Y. Hiraki (*J. Chem. Soc. Japan*, 1940, 61, 827—834, 835—838, 937—947, 1005—1013; *Rev. Phys. Chem. Japan*, 1941, 15, 70).—The rate of reaction between NO and O_2 at low temp. and pressure has been studied by the static and flow methods, using a Pirani manometer. At 10^{-3} mm. the reaction is strongly catalysed by a previously condensed Hg film on the surface of the vessel, whilst a Hg film condensed during the reaction produces scarcely any effect. The catalytic activity increases with increasing thickness of the Hg film until the latter corresponds with 100 at. layers, after which it remains const. NO has been shown to be adsorbed on the film much more strongly than O_2 , and it is inferred that reaction is produced by the striking of O_2 mols. on adsorbed NO mols. The velocity of the reaction follows the relation $-d[O_2]/dT = k[NO][O_2]/[N_2O_4]$. The catalytic activity is approx. const. at -140° but decreases with rising temp. and at $\sim -120^\circ$ falls suddenly. This is attributed to rearrangement of randomly deposited Hg atoms into a regular cryst. structure, and on this basis the velocity of surface migration of Hg atoms has been measured at various temp. by observation of the rate of decrease of catalytic activity. J. W. S.

Thermal decomposition of nitrogen pentoxide by a platinum surface. I, II. N. Sasaki and Y. Hiraki (*J. Chem. Soc. Japan*, 1940, 61, 812—817, 818—826; *Rev. Phys. Chem. Japan*, 1941, 15, 69—70).— N_2O_5 at 0° and 10^{-4} – 10^{-5} mm. pressure is decomposed with measurable velocity on a Pt surface at 30° , whilst with the surface at $>400^\circ$ all mols. striking it are decomposed. From the reaction velocity the heat of activation is 8–13 kg.-cal. per g.-mol., a val. \gg for the homogeneous reaction. Decomposition into N_2O and O_2 probably occurs. J. W. S.

Action of magnetised ferro-magnetic catalyst. E. Ogawa (*Tech. Rep. Kyushu Imp. Univ.*, 1939, 14, 243—261; *Rev. Phys. Chem. Japan*, 1941, 15, 69).—The theory of p - $H_2 \rightarrow$ o - H_2 conversion and related phenomena is discussed. It is concluded that the action of reacting mols. on spins of valency electrons in the presence of a ferromagnetic catalyst is retarded by magnetisation of the catalyst. This view is confirmed by measurements on the reactions between C_2H_4 and H_2 and between $CH_3CH_2CH_2Br$ and HBr in the presence of Ni or stainless steel. When a solution of $Fe(CNS)_3$ in Et_2O and HCl are placed together in a magnetic field formation of $FeCl_2$ is promoted; it is inferred that perturbation on the interface is produced by the field. Hence it is concluded that perturbation may affect the rate of reaction of C_2H_4 and H_2 . The velocity of reaction between C_2H_4 and H_2 on a constant wire is reduced when a high potential is applied to the wire. J. W. S.

Dehydrogenation of n -heptane and cyclohexane on cerium, vanadium, and thorium oxide catalysts. R. A. Briggs and H. S. Taylor (*J. Amer. Chem. Soc.*, 1941, 63, 2500—2503).—The effects of temp. in the range 470° to 555° , mode of prep. of catalyst, deposition of catalyst on Al_2O_3 , and reactant feed rate on the aromatisation of n - C_7H_{14} and cyclohexane by the catalysts CeO_2 , V_2O_5 , and ThO_2 have been severally investigated. The order of aromatisation activity was $V_2O_5 > CeO_2 > ThO_2$. With CeO_2 and ThO_2 the yields of aromatics are $<$ those of patent claims. V_2O_5 is comparable with but inferior to CrO_3 . Deposition on Al_2O_3 increases cracking effects for CeO_2 and V_2O_5 . ThO_2 possesses dehydrogenating activity, but is a poor aromatisation catalyst. W. R. A.

Promoting action of mercury on aluminium oxide in the reaction of dehydration of ethyl alcohol. V. M. Nikitin and N. V. Razumov (*J. Gen. Chem. Russ.*, 1941, 11, 133—135).—The catalytic activity of Al_2O_3 in the reaction of production of C_2H_4 from $EtOH$ is greatly enhanced by addition of 0.5% of Hg. R. T.

Platinised silica gel as a catalyst in gas analysis.—See B., 1941, I, 484.

[Catalytic] vapour-phase synthesis of vinyl acetate.—See B., 1941, II, 365.

Catalytic reduction of naphthenic acids.—See B., 1941, II, 365.

Deposition of metallic powder by electrolysis. S. Kaneko and K. Kawamura (*Bull. Electrochem. Lab.*, 1940, 4, 821—823; *Rev. Phys. Chem. Japan*, 1941, 15, 66).—In the electrolysis of aq. CuSO_4 and ZnSO_4 , $i\tau^{0.5} = \text{const.}$, where i is the c.d., and τ is the time needed before metallic powder begins to appear on the cathode. J. W. S.

Kinetics and mechanism of electro-reduction of amides.—See A., 1941, II, 363.

Chemical syntheses by means of electric discharges and the improvement of their yields. E. Briner (*Arch. Sci. phys. nat.*, 1941, [v], 23, 79—96; cf. A., 1941, I, 304).—The author's investigations on the synthesis of HCN , C_2H_2 , NH_3 , and O_3 are summarised. The general mechanisms of the reactions involved are discussed with special reference to the primary processes, reactions of the activated particles, and the prevention of the decomp. of the product. J. W. S.

Volume and surface processes in the oxidation of nitrogen in the glow discharge. III. B. A. Konovalova and N. I. Kobosev (*J. Phys. Chem. Russ.*, 1940, 14, 628—641; cf. A., 1939, I, 619).—Oxidation of N_2 by O_2 in a glow discharge is retarded by H_2O vapour. It is assumed that the reaction velocity v_1 in presence of H_2O is that of the reaction in space, and the difference v_2 between the rate in absence of H_2O and v_1 is the velocity of the surface reaction. The reaction vessel was of quartz. At 4000—6000 v., 100 ma., and 215 mm. Hg v_1 shows a max. at N_2 60, O_2 40, and v_2 at N_2 25, O_2 75%. The ratio $v_2 : (v_1 + v_2)$ increases with $[\text{O}_2] : [\text{N}_2]$. In air v_1 generally increases with pressure (70—690 mm. Hg), and v_2 is max. near 215 mm. and falls at high pressures to zero or to negative vals. The lowering of v_2 at high pressure is presumably due to a reduced speed of diffusion of ionised clusters to the walls. In air at 215 mm. v_1 has identical vals. for 0.44%—2.10% of H_2O , but $[\text{NO}]$ in the discharge tube is lowered when $[\text{H}_2\text{O}]$ rises. In air at 215 mm. both v_1 and v_2 increase when the current increases (33—150 ma.) but the rise of v_2 is 3 times as steep as that of v_1 . The easy poisoning of the N_2 oxidation shows that it is of a non-thermal nature. J. J. B.

Reactions of nitrogen dioxide with other gases. L. Harris and B. M. Siegel (*J. Amer. Chem. Soc.*, 1941, 63, 2520—2523).— NO_2 , under the influence of ultra-violet radiation, dissociates according to $\text{NO}_2 + h\nu \rightarrow 2\text{NO} + \text{O}$. The reaction of O atoms with gases can be studied if the gases are not dissociated by the radiation employed and do not react with NO_2 in the dark. A low partial pressure (1—10 mm.) of NO_2 was utilised to minimise the reaction $\text{NO}_2 + \text{O} = \text{NO} + \text{O}_2$. MeOH and HCl react rapidly with NO_2 in the dark. CO and CH_4 do not react with NO_2 in the dark or under ultra-violet irradiation at temp. $<250^\circ$. CS_2 and C_2H_4 do not react with NO_2 in the dark but on irradiation with $>3100 \text{ \AA}$. react with NO_2 at room temp. W. R. A.

Rates of reaction of excited mercury with oxygen, hydrogen sulphide, and nitrous oxide and their relation to effective collision diameters. J. E. Cline and G. S. Forbes (*J. Amer. Chem. Soc.*, 1941, 63, 2152—2157).—Reaction rates of Hg^* with (i) O_2 at 0° , 25° , and 45° , (ii) H_2S at 0° and 23° , and (iii) N_2O at 0° have been investigated and corr. for light absorption by solid Hg compounds and (i) at 45° for photolysis of HgO . The half pressures corresponding with half the max. reaction rate at a given temp. are respectively (i) 0.04, 0.25, and 0.3 mm., (ii) 0.5 and 0.25 mm., and (iii) 0.32 mm. λ of $<2537 \text{ \AA}$. is not necessary for the photosensitised $\text{Hg}-\text{O}_2$ reaction (cf. A., 1928, 140). Vals. of σ^2/f where σ is the sum of collision radii with Hg and f the fraction of fluorescence radiation escaping reabsorption, are for (i) 480, 76, 76, $\times 10^{-16} \text{ cm}^2$, (ii) 37, 77, $\times 10^{-16} \text{ cm}^2$, and (iii) 64 $\times 10^{-16} \text{ cm}^2$, respectively. Comparison of σ^2/f with σ^2 obtained from viscosity data suggests that the quenching efficiencies of O_2 , N_2O , and H_2S on resonance radiation are in the ratio 1.0 : 0.8 : 0.5. W. R. A.

Photochemical formation of sulphur monoxide. V. Kondratiev and A. Jakovleva (*J. Phys. Chem. Russ.*, 1940, 14, 859—862).— S_2O_2 is formed when SO_2 (0.5 mm. Hg) is irradiated by waves $<2000 \text{ \AA}$. When SO_2 is irradiated in presence of a large excess of COS ($\sim 50 \text{ mm. Hg}$) waves $>2260 \text{ \AA}$. are also active. No S_2O_2 is formed when COS contains CS_2 and other impurities. Presumably COS dissociates in light to CO and S, and S gives S_2O_2 with SO_2 . The monoxide must be S_2O_2 as the formation of SO is energetically impossible. J. J. B.

Formation of CS in the photodissociation of carbon disulphide and carbonyl sulphide. V. Kondratiev and A. Jakovleva (*J. Phys. Chem. Russ.*, 1940, 14, 853—858).—CS is formed when CS_2 or COS vapour is irradiated with waves of $\lambda < 2370 \text{ \AA}$; the threshold for CS_2 is presumably at 2068 \AA . The decay of CS is due to its adsorption on the walls of the vessel (quartz). The rate of adsorption $\propto [\text{CS}]$ and is $<$ that of diffusion. The stationary $[\text{CS}] \propto$ the intensity of irradiation. When the walls are not clean enough the stationary $[\text{CS}] = 0$. J. J. B.

Oxidation of adsorbed carbon monoxide by atomic oxygen. M. M. Pavliutschenko (*J. Phys. Chem. Russ.*, 1940, 14, 605—614).—At a pressure $<0.1 \text{ mm. Hg}$, O produced by irradiation of O_2 with 1750—1300 \AA . is adsorbed by quartz, Ag, or Pt walls; when the irradiation ceases O returns to the gas phase as O_2 from quartz but not from metal surfaces. The amount adsorbed on metals in liquid air corresponds with 0.7—1.1 of the unimol. layer. When $\text{CO}-\text{O}_2$ mixtures are irradiated with 1750—1300 \AA , CO_2 is formed. The rate of reaction increases linearly with the intensity of irradiation and with the pressure of O_2 (0.02—0.2 mm. Hg); it is independent of the pressure of CO above 0.001—0.004 mm. Hg. At a const. pressure it is (in quartz) at room temp. 1.6 times $<$ in liquid air, and at a const. concn. it is 1.7 times as high at room temp. as in liquid air. In metal vessels in liquid air it was 1.6 times as high as in quartz. When O_2 is irradiated, the irradiation stopped, and CO introduced, no formation of CO_2 takes place. Evidently CO_2 is formed from adsorbed CO and at. O striking the walls. On quartz 40—45% (in liquid air) and 70—80% (at room temp.) of the O produced is used for oxidation of CO; the val. is 80—90% for Ag and Pt. On quartz treated with H_2O or Hg vapour the val. is 5—7% or 8%, respectively. No activation energy is required for the oxidation of CO by O. J. J. B.

Kinetics of the photochemical formation of phosgene. P. M. Fye and J. J. Beaver (*J. Amer. Chem. Soc.*, 1941, 63, 2395—2400).—The effect of third-body collisions with CF_2Cl_2 on the photochemical formation of COCl_2 has been investigated and is discussed in terms of the Bodenstein and Lenher-Rolfsen mechanisms, both of which postulate $\text{COCl} + \text{Cl}_2 \rightarrow \text{COCl}_2 + \text{Cl}$ as the chief chain-breaking reaction. From the positions of the "break" in the experimental curve at different light intensities, total pressures, and ratios of components and the decrease in reaction rate as the reaction nears completion it is concluded that the assumed chain-breaking processes explain these "breaks" and that their position is given by $P_{\text{Cl}} = K[P_{\text{Cl}_2}/P_{\text{CO}}]^{1/2} + B$. W. R. A.

Mechanism of photochemical change of acetylene. B. L. Dunicz (*J. Amer. Chem. Soc.*, 1941, 63, 2461—2472).—The photochemical polymerisation of C_2H_2 irradiated by a quartz Hg lamp has been studied by recording the absorption spectra of $\text{CH}_2\text{C}=\text{CH}:\text{CH}_2$ (I), of an enclosed vol. of (i) (I) in the gaseous phase over 341 to 5.5 mm., diluted with N_2 , and in the solid state, (ii) (I) alone and in admixture with C_2H_2 , (iii) C_6H_6 in admixture with C_2H_2 and with (I), and (iv) C_2H_2 and (I) in continuous and intermittent flow at low pressure. C_2H_2 below 2350 \AA . decreases in pressure and the main products of the polymerisation are a yellow powder similar to cuprene and small amounts of C_6H_6 , both of which increase steadily during the reaction; from 341 to 5.5 mm., in the solid state and in dilution with N_2 , the reaction products are essentially the same; irradiation by a Pb spark gives no qual. differences in the course of the reaction. The first step in the polymerisation chain is attributed to the formation of a dimeride, *cyclobutadiene* (II) in an excited state, and not to (I) which may be produced as a side product from C_2H_2 by irradiation at very low pressure. From (I) two intermediate trimerides are identified as reactive acetylenylcyclobutenes. $(\text{CH}_2\text{CH}=\text{C})_2$ and acetylenyldivinyl found in (ii) are attributed to isomerisation of unstable intermediate vinylcyclobutadiene. The production of C_6H_6 and of C_{10}H_8 in (iii) with C_2H_2 is attributed to reaction of C_2H_2 with (II) and of irradiated C_2H_2 with C_6H_6 . The average chain length is considered to depend on the relative probability of formation of inactive aromatic isomerides in agreement with the postulate that C_2H_2 ought to be responsible for the continuation and termination of the polymerisation chain. W. R. A.

Photodecomposition of gaseous acetone. II. R. Spence and W. Wild (*J.C.S.*, 1941, 590—596).—The results of the authors (A., 1937, I, 253) and of Herr and Noyes (A., 1940, I, 417) are discussed. Data for the decomp. of COMe_2 in the

region of continuous absorption agree with a modified form of the author's previous theory (*loc. cit.*). It is suggested that in the region of banded absorption at low pressures an excited mol. is formed on absorption which ultimately decomposes with the formation of free radicals. At higher pressures the excited mol. may be converted by collision into a metastable state, mean life $\sim 10^{-2}$ sec., which may either revert to the ground state on collision or decompose directly into C_2H_2 and CO without the formation of radicals. O. D. S.

Photolysis of some chloronitroso-compounds.—See A., 1941, II, 349.

Effect of temperature and light on 2:6-dichlorophenol-indophenol solutions.—See A., 1941, II, 359.

Photosynthesis in intermittent illumination.—See A., 1941, III, 939.

Mechanism of the oxidising action of supersonics. S. E. Bresler (*J. Phys. Chem. Russ.*, 1940, 14, 309—311).—Solutions of 3-aminophthalhydrazide (luminol) (I) radiate in a supersonic field much more light than if (I) is added to a solution after it has been subjected to supersonics. Elimination of O_2 from the solution or keeping it under 3 atm. of O_2 prevents the emission of light, since cavitation ceases in absence of gas or under pressure. Cavitation produced by expansion of liquid entering a large vessel through a narrow capillary causes no light emission, presumably because of the slow formation of these cavities. Addition of Et_2O or NH_3 to the solution of (I) extinguishes its luminescence since these substances increase the gas pressure in the cavities and, therefore, hinder discharge therein (cf. Frenkel, A., 1941, I, 449). J. J. B.

IX.—METHODS OF PREPARATION.

Corrosion of copper and α -brass.—See B., 1941, I, 502.

New group of isomorphous compounds, A_2XO_4 . M. A. Bredig (*J. Amer. Chem. Soc.*, 1941, 63, 2533).—From X-ray data a new group of isomorphous compounds has been recognised. They have the generic formula A_2XO_4 and hexagonal unit cell containing 2 mols., space-group D_{3d}^2 . A^+SO_4 , A^+AlPO_4 , and Ca_2SiO_4 modified by PO_4 as in furnace slags, belong to this class particularly at high temp. It is likely that other compounds with $X = Cr, V, Mo, W, As$, and Se will also belong to it at high temp. The high-temp. forms can be stabilised by addition of substances insol. in the low-temp. forms, e.g. A^+XO_3 , A^+XO_4 , $A^+(XO_3)_2$. The alleged "binary compounds" $CaNa_2(SO_4)_2$ and $K_2Na(SO_4)_2$ are actually solid solutions of $CaSO_4$ in α - Na_2SO_4 and of Na_2SO_4 in α - K_2SO_4 , respectively. W. R. A.

Reactions in the solid state at higher temperatures. V. Reaction between magnesium oxide and stannic oxide in the solid state. Y. Tanaka (*J. Chem. Soc. Japan*, 1940, 61, 1023—1028; *Rev. Phys. Chem. Japan*, 1941, 15, 59).— $2MgO \cdot SnO_2$ is the only stable compound formed by reaction between MgO and SnO_2 in the solid state. At 1400° the reaction is almost complete in 10 hr., the initial composition of the product being $MgO \cdot SnO_2$, from which the excess of SnO_2 in solid solution gradually separates. At 1000 — 1100° the heat of activation of the reaction is ~ 100 kg.-cal. per g.-mol., a val. \gg for reaction between TiO_2 and MgO or CaO . $2MgO \cdot SnO_2$ has a spinel structure and is sol. in $2MgO \cdot 4NH_4Cl$. J. W. S.

Hydrated nitrates of rare earth elements. J. K. Marsh (*J.C.S.*, 1941, 561—562).— $Dy(NO_3)_3 \cdot 6H_2O$ (I) was formed by crystallisation from H_2O . When (I) was crystallised from conc. HNO_3 , $Dy(NO_3)_3 \cdot 5H_2O$ (II) separated. $Y(NO_3)_3 \cdot 5H_2O$ was formed when a neutral solution of $Y(NO_3)_3$ was seeded with $Bi(NO_3)_3 \cdot 5H_2O$ (III). The mother-liquor when seeded with (I) gave crystals of $Y(NO_3)_3 \cdot 6H_2O$. $Yb(NO_3)_3 \cdot 5H_2O$ crystallised from aq. solution spontaneously or on seeding with (III). $Yb(NO_3)_3 \cdot 4H_2O$ has been obtained by crystallisation from dil. HNO_3 . Crystallisation of the warm conc. solution gave $Yb(NO_3)_3 \cdot 3.5H_2O$. $Yb(NO_3)_3 \cdot 3H_2O$ was not obtained. $Lu(NO_3)_3 \cdot 5H_2O$ was formed on seeding an aq. solution with (III). $Lu(NO_3)_3 \cdot 4.5H_2O$ was obtained by seeding with $Sr(NO_3)_2 \cdot 4H_2O$. O. D. S.

Carbonyls. J. Kenner (*Nature*, 1941, 148, 345).—A discussion. L. S. T.

Corrosion of tin: effects of cations in carbonate solutions and effects of alloying elements.—See B., 1941, I, 564.

Influence of structure of electrolytic chromium on its oxidisability.—See B., 1941, I, 505.

Manganese nitrosyl cyanide salts. A. A. Blanchard and F. S. Magnusson (*J. Amer. Chem. Soc.*, 1941, 63, 2236—2237).— $K_2[Mn(CN)_5NO]$ (I) (improved prep.) is stable in a closed container in the absence of light. With H_2O (I) yields a $KMnO_4$ -coloured solution which becomes turbid after a day and a black film collects on the walls of the container. $2N \cdot HNO_3$, H_2SO_4 , and HCl have no immediate action on the aq. solution of (I) but after ~ 2 hr. the colour becomes yellow. The colour changes produced by aq. NH_3 and $NaOH$, $(NH_4)_2S$, and solutions in $N \cdot HNO_3$, H_2SO_4 , and HCl of salts of Al, Cd, Co, Cu, Fe^{III} , Fe^{II} , Pb, Mn, Hg^{II} , Ni, and Zn are recorded. Attempts to prepare $K[Co(CN)_5NO]$ and $K_2[Co(CN)_5CO]$ by adding KOH and KCN to a suspension of CoO_2 and Co_2O_3 and saturating the suspensions with NO and CO were unsuccessful. Instead $K_3[Co(CN)_6]$ and $K[Co(CN)_4]$ were formed and in both the effective at. no. of Co is 36. W. R. A.

X.—ANALYSIS.

Spectrographic analysis. J. S. Foster (*Canad. Chem.*, 1941, 25, 504, 506, 515).—A brief description.

Micro-chemical analysis and its applications. R. Belcher (*Chem. and Ind.*, 1941, 605—610).—A lecture. The development of micro-methods and their applications in spot tests and electrographic, gas, polarographic, and quant. org. analysis are discussed. The applications of the methods to the determination of N, C, H, S, and Cl in coal are detailed. J. W. S.

Mixed indicator for detection of carbonates in water.—See B., 1941, III, 303.

[Preparation of] standard solutions. R. L. Vandaveer (*J. Assoc. Off. Agric. Chem.*, 1941, 24, 628—631).—A review of papers by Deal, Conroy, and Johnson (see below). A. A. E.

Standardisation of sulphuric acid. H. W. Conroy (*J. Assoc. Off. Agric. Chem.*, 1941, 24, 636—639).—The Pickering-Marshall sp. gr. method for simultaneous prep. and standardisation of H_2SO_4 solutions permits duplication of results by different analysts with a high degree of accuracy. A. A. E.

Detection and determination of mineral acid in vinegar.—See B., 1941, III, 285.

[Preparation of] standard solutions of iodine and arsenite. G. M. Johnson (*J. Assoc. Off. Agric. Chem.*, 1941, 24, 639—641).—When the detailed directions given for the prep. of standard $NaAsO_2$ solution and the standardisation of I solution were followed, collaborative results for the concn. of an "unknown" $NaAsO_2$ solution showed a max. error of 0.2% (average 0.1%). A. A. E.

[Preparation of] silver nitrate and thiocyanate standard solutions. E. C. Deal (*J. Assoc. Off. Agric. Chem.*, 1941, 24, 631—635).—Fajans' (absorption indicator), Mohr's, and Volhard's methods all give satisfactory results for standardisation of $AgNO_3$ solutions if end-point corrections are applied where necessary. Fajans' method is equally satisfactory with KCl and fluorescein or KBr and eosin, but $AgBr$ with adsorbed eosin is very sensitive to light; hence KCl with fluorescein is preferred. Averaged collaborative results indicate that the expected deviation in normality is $\pm 0.1\%$. A. A. E.

Anhydrous sodium thiosulphate, a primary standard. H. M. Tomlinson and F. G. Ciapetta (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 539—540).—Reaction velocity measurements with $CH_2Br \cdot CO_2Na$ show that $Na_2S_2O_3$ is stable during 79 days' heating at 120° . The dehydration of $Na_2S_2O_3 \cdot 5H_2O$ furnishes an anhyd. salt that fulfils the requirements of a primary standard. Data for the analysis of I solutions by $Na_2S_2O_3$ and by As_2O_3 show good agreement between the methods. Recrystallisation of the C.P. salt may not be necessary when an accuracy $\pm 0.2\%$ is required. $Na_2S_2O_3 \cdot 5H_2O$ should be dried at 120° to const. wt., and stored over $CaCl_2$. $Na_2S_2O_3$ is not appreciably hygroscopic, and can be re-dried to const. wt. in 2 hr. at 120° . It is stable in light and in presence of moisture. L. S. T.

Separation of ozone from other gases. J. L. Edgar and F. A. Paneth (*J.C.S.*, 1941, 511—519; cf. A., 1938, I, 478).—The previously published method (*ibid.*) is described in

detail. Vals. for the v.p. of NO_2 condensed on glass and on SiO_2 gel are given for temp. -72° to -52° . O. D. S.

Measuring low [hydrogen] sulphide concentrations.—See B., 1941, III, 304.

Micro-Kjeldahl determination of nitrogen.—See A., 1941, II, 385.

Electrometric and conductometric studies of neutralisation reactions of phosphoric acid. Neutralisation of very dilute solutions of phosphoric acid with sodium hydroxide. C. C. Higgins, D. R. McCullagh, F. Hovorka, and E. E. Mendenhall (*J. Amer. Chem. Soc.*, 1941, 63, 2295—2298).— H_3PO_4 has been determined over the concn. range 0.000275—0.000967M. by electrometric and conductometric titration against 0.0205M-NaOH. The first stoichiometric point is indicated respectively by an inflexion in the curves and by a max. Within the concn. range studied, the second stoichiometric point could not be ascertained from the second inflexion point by either method. W. R. A.

Determination of carbon in pyrites concentrates and in difficultly combustible substances.—See B., 1941, I, 494.

Separation of calcium nitrate from strontium nitrate by ethylene glycol monobutyl ether [butyl Cellosolve]. H. H. Barber (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 572—573).— $\text{Ca}(\text{NO}_3)_2$ is separated from $\text{Sr}(\text{NO}_3)_2$ by extraction of the former by means of $\text{OH} \cdot [\text{CH}_2]_2 \text{OBU}$ (I). Both the nitrates and the solvent are dehydrated by boiling in (I) (b.p. 170.6°). The solubility of anhyd. $\text{Ca}(\text{NO}_3)_2$ in (I) is 2.43×10^{-1} g. per ml., whilst that of anhyd. $\text{Sr}(\text{NO}_3)_2$ and of anhyd. $\text{Ba}(\text{NO}_3)_2$ is $>$ that of SrCO_3 and BaSO_4 , respectively, in H_2O . A semi-micro-procedure for the qual. analysis of the alkaline earth group is detailed. L. S. T.

Determination of metals by means of 8-hydroxyquinoline. Examination of oxine precipitates, using X-ray diffraction methods. R. C. Chirnside, C. F. Pritchard, and H. P. Rooksby (*Analyst*, 1941, 66, 399—407).—Correlation of loss in wt. on drying with X-ray diffraction patterns (cf. B., 1940, 288; 1941, I, 312) of oxine ppts. established the following satisfactory drying temp. for quant. work: $\text{Mg}(\text{C}_6\text{H}_7\text{ON})_2 \cdot 2\text{H}_2\text{O}$, 98° or 110° ; $\text{Mg}(\text{C}_6\text{H}_7\text{ON})_2$, 160° ; $\text{Zn}(\text{C}_6\text{H}_7\text{ON})_2 \cdot 2\text{H}_2\text{O}$, 98° ; $\text{Zn}(\text{C}_6\text{H}_7\text{ON})_2$, 160° ; $\text{Al}(\text{C}_6\text{H}_7\text{ON})_3$, 98° , and $\text{Fe}(\text{C}_6\text{H}_7\text{ON})_3$, 98° ; drying times are given. Quant. separations, as their oxine compounds, of Zn from Mg and of Al from Fe are difficult owing to copptn. X-Ray analysis shows the hydrated Zn and Mg oxinates to be isomorphous and so to form a continuous series of solid solutions. Fe and Al oxinates are not isomorphous and form solid solutions of one phase up to the ratio Al:Fe = 2:1, but with higher proportions of Al free Al oxinate occurs as a separate phase. Changes in composition occur on ageing. There was no evidence of adsorption (cf. A., 1938, I, 324). S. T. P. B.

Test for heavy metals in hypophosphorus acid. R. A. Keuver and K. H. Stahl (*Amer. J. Pharm.*, 1941, 113, 327—328).— H_3PO_2 is converted into Na_2PO_4 by oxidation with H_2O_2 followed by neutralisation and evaporation. The resulting salt is dissolved in dil. HCl and treated with H_2S . This procedure avoids the pptn. of S. D. D.

Colorimetric determination of copper with ammonia. Spectrophotometric study. J. P. Mehlig (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 533—535).—Spectrophotometric investigation shows that the NH_3 method for Cu^{++} is satisfactory with few limitations. Yoe's procedure ("Photometric Chemical Analysis," 1928, Vol. 1, p. 176) is recommended. The concn. of aq. NH_3 used for dilution must be controlled because max. absorption and the λ of max. absorption increase with an increase in $[\text{NH}_3]$. A 3M. solution is recommended. The colour system obeys Beer's law, and the colour is stable in diffuse light for <6 weeks, and probably indefinitely. Interfering anions are citrate, CN^- , tartrate, and $\text{S}_2\text{O}_3^{--}$; $\text{P}_2\text{O}_7^{--}$ and salicylate; $\text{Cr}_2\text{O}_7^{--}$, which produces a change in hue owing to its own colour; and chlorostannate, chlorostannite, tungstate, and vanadate, which cause turbidity either by hydrolysis, or by pptn. of Cu salts. Co^{++} and Ni^{++} are the only common cations that interfere seriously. NH_4^+ as sulphate has a negligible effect on the colour, 200 p.p.m. of NH_4^+ as chloride cause an error of $+2\%$ in $[\text{Cu}]$ and <500 p.p.m. and error of $+3.3\%$. L. S. T.

[Electrolytic] determination of copper and nickel in german-silver.—See B., 1941, I, 503.

Determination of cerium in monazite sand.—See B., 1941, I, 495.

Determination of lead in biological material.—See A., 1941, III, 944, 1087.

Thiocyanate method for [determination of] iron. Spectrophotometric study. J. T. Woods with M. G. Mellon (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 551—554).—Conditions affecting the coloured system resulting from the interaction between Fe^{+++} and CNS^- have been investigated critically by means of a spectrophotometer. NH_4CNS is preferable to $\text{HCNS} + \text{Hg}(\text{CNS})_2$ as the colour-forming reagent, and since intensity of colour depends on the amount used, this factor must be controlled carefully. Addition of COMe_2 as a solvent increases the sensitivity of the method, improves the stability of the colour, and lessens the interferences due to F^- , but introduces difficulty with some salts insol. in $\text{H}_2\text{O} + \text{COMe}_2$. HNO_3 is preferable to H_2SO_4 or HCl , and with this acid ϕ_H should be maintained at <1 both in H_2O and in $\text{H}_2\text{O} + \text{COMe}_2$. With HNO_3 , Beer's law holds between ϕ_H 1.2 and 1.5 only. Of the 27 cations studied, only Al^{+++} , NH_4^+ , Be^{++} , Ce^{+++} , Li^+ , Mg^{++} , Mn^{++} , K^+ , and Na^+ interfere by $<2\%$ when present in concns. 250 times that of the Fe^{+++} , and of the 30 anions studied only, OAc^- , AsO_4^{--} , OBz^- , Br^- , CO_3^{--} , Cl^- , CN^- , citrate, formate, salicylate, tartrate, NO_3^- , PO_4^{--} , silicate, and SO_4^{--} do not interfere by $>$ this amount. Except for a slight fading after several months, an ammoniacal solution of hexamminocobaltic nitrate and pentamminoquocobaltic chloride is an improved colour standard. The CNS method is inferior to several others especially those using *o*-phenanthroline, 2:2'-dipyridyl, or AcSH . L. S. T.

Assay of Blaud's [iron] pills.—See B., 1941, III, 295.

Application of photo-electric colorimeter. Determination of bismuth in biological materials.—See A., 1941, III, 946.

Volumetric determination of gold by means of potassium iodide and arsenious acid. V. E. Herschlag (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 561—563).—Au in aqua regia is determined by adding NaOCl or KClO_3 to liberate excess of Cl_2 , and so remove NOCl , diluting and boiling out the excess of Cl_2 , neutralising with an excess of NaHCO_3 , adding KI , which reduces Au^{+++} to Au^+ and dissolves the AuI as the complex iodide, and titrating the liberated I with Na_2AsO_3 (starch, if desired). Cu, Fe, and other base metals do not interfere, but their basic carbonates may render the end-point more difficult to observe. Pt and Pd do not ppt. or liberate I , but the strongly-coloured complex iodides formed obscure the end-point. L. S. T.

XI.—APPARATUS ETC.

Rapid preliminary determination of m.p. G. W. Stahl (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 545).— >2 mg. of the finely-ground solid are placed on the bulb of an ordinary thermometer having a thin glass Hg reservoir. The thermometer is held horizontally 8 in. above a 2—3-in. Bunsen flame, and lowered 1 in. per 10 sec. M.p. found by this method for a no. of substances are compared with those determined by using an oil-bath. The average time required for a single determination is <1 min. L. S. T.

Absorption spectroscopy using the hydrogen lamp. F. Müller and W. Scholtan (*Angew. Chem.*, 1940, 53, 552—556).—A comparative study of the light sources, using the comparison spectrum method on EtOH solutions of C_6H_6 , shows that the H_2 discharge tube and the Fe spark give equally good results; with the former, details falling in gaps in the Fe spectrum are observed. Improvements in design and voltage regulation should render the H_2 tube suitable for use in precision measurements. Stücklen's method (cf. A., 1939, I, 237) gives poor results for diffuse bands, but is suitable for many routine purposes. A. J. E. W.

Slide rule for X-ray diffraction by cubic crystals. D. E. Thomas (*J. Sci. Instr.*, 1941, 18, 205).—The slide rule, on the two fixed scales of which are vals. of λ and $\sin \theta$ and on the slider are vals. of a and $(h^2 + k^2 + l^2)^{\frac{1}{2}}$, permits the solution of problems involving the Bragg relation $\lambda(h^2 + k^2 + l^2)^{\frac{1}{2}} = 2a \sin \theta$. The use of the rule for choosing an anode for back-reflexions is described. C. R. H.

Photo-electric fluorimeter. G. F. Lothian (*J. Sci. Instr.*, 1941, 18, 200—202).—The construction of the fluorimeter which uses two photo-cells in a null circuit is described. For

determining the concn. of a fluorescing solution the ratio of its fluorescence to that of a suitable standard is determined. A theoretical consideration of errors shows that the greatest accuracy in determining concn. is obtained when the density of absorption of the solution for the radiation inducing the fluorescence = 0.43. The use of dil. solutions is indicated since it is then possible to detect and allow for the presence of impurities. This is illustrated by data on the fluorescence of uranine, alone and in presence of β -C₁₀H₇OH. At concns. $< \sim 0.06$ fluorescence \propto concn., and the effect of the β -C₁₀H₇OH can be eliminated by the use of a suitable colour filter. C. R. H.

X-Ray camera for materials of large grain size. C. Wainwright (*J. Sci. Instr.*, 1941, 18, 203).—If a translatory movement is added to the oscillation normally given to materials of large grain size, a considerable area of the specimen can be scanned by the X-ray beam. The construction of such an instrument and of a simple film holder is described.

Cuprous oxide photo-cells. G. Berraz and E. Virasoro (*Anal. Inst. invest. cient. tecn.*, 1938—1939, 8—9, 27—55).—Description of the technique for prep. of a barrier-layer electrode by regulated oxidation of Cu at 1000° and reduced pressure. The photo-cells so obtained have a high photo-potential up to 460 mv. The photo-electric properties are attributed to an adsorbed layer of gas, as in the thermal destruction of the barrier the Cu₂O is not fundamentally affected. F. R. C.

Photo-electric saccharimeter.—See B., 1941, III, 284.

New form of diffractometer.—See A., 1941, III, 946.

Development of electrolytic analysis apparatus. R. B. Brock (*Chem. and Ind.*, 1941, 596—599).—The development of apparatus for routine electrolytic analysis is discussed, with particular reference to the different methods used for stirring. Two modern forms of apparatus with concentric rotating electrodes and independent stirring mechanism, respectively, are described in detail. J. W. S.

Mass spectrometer for isotope analysis. H. Brown, J. J. Mitchell, and R. D. Fowler (*Rev. Sci. Instr.*, 1941, 12, 435—441).—Constructional details for a 180° Dempster-type mass spectrometer and its stabilisation circuits are described and figured. The ions have a radius of curvature of 15 cm., and are accelerated through a p.d. of 2000 v. An oil diffusion pump was successfully used. The instrument gives steady and consistent peaks and low backgrounds. The accuracy of the peak ratios is $\sim 0.3\%$. A. A. E.

Stereoscopic photographs with the electrostatic electron microscope. H. Mähl (*Naturwiss.*, 1940, 23, 264).—In order to secure stereoscopic photographs of objects with the electrostatic electron microscope, the objects are photographed at different angles. A. J. M.

RCA electron microscope. H. E. Rhea (*Wallerstein Lab. Comm.*, 1941, 4, 99—106).—Further details of the instrument (A., 1941, I, 391) are given, with illustrative micrographs.

Metallic smokes as test objects in electron microscopy. R. B. Barnes and C. J. Burton (*News Ed., Amer. Chem. Soc.*, 1941, 19, 965—967).—Oxide smokes of Mg, Zn, and W, photographed with the electron microscope, show crystals agreeing in form with known macroscopic crystals of MgO, ZnO, and WO₃. Al gives spherical particles of a wide variety of sizes, whilst C black shows spheroidal particles of uniform size. All the above are well suited for use as test objects in electron micrographic technique. Fe, Cd, Ca, and Sn oxide smokes are less well defined. L. J. J.

Apparatus for determination of small quantities of radium. W. D. Urry and C. S. Piggot (*Amer. J. Sci.*, 1941, 239, 633—657).—The apparatus described evaluates 1×10^{-14} g. of Ra within an observational period of 20 hr. by measuring the ionisation produced by the Rn liberated from the powdered sample by heating in a vac. furnace at high temp. Advantages include high precision, the elimination of fluxes and chemical manipulation, automatic calibration every hr., automatic compensation of extraneous ionisations, and continuous recording on a moving film for any desired period of time. Measurements ranging from 0.003 to $25 (\times 10^{-12})$ g. of Ra per g. or c.c. of solids and liquids have been made, and data for the Ra contents of ocean sediments and the loss of Rn from them are recorded. L. S. T.

Device for starting the swinging of a balance. R. E. Vollrath (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 564—565).—The pull of a small electromagnet on a piece of soft Fe or steel mounted on the beam or pans of the balance is utilised in the device described and illustrated. A push-button switch sets the magnet in operation. The amplitude of swing can be controlled even while the beam is swinging. L. S. T.

Surface motion of sputtered particles. K. I. Roulston (*Proc. Camb. Phil. Soc.*, 1941, 37, 440—442; cf. A., 1933, 213).—The deposits formed by allowing an unspecified sputtered material to fall on glass or Au targets through a fine grating of wires, spacing < 0.01 mm., have been examined. The presence of sputtered material in the shadow of the wires indicates that surface motion can occur in the sputtered deposit. Measurements of the total density of the deposit for different spacings of the wires indicate that this is always $<$ that expected if no re-evaporation occurs. The defect becomes greater as the width of the spacing decreases. O. D. S.

Adjustable agitator for laboratory use. N. G. Heatley (*J. Sci. Instr.*, 1941, 18, 204).—An electric non-synchronous gramophone motor is so mounted that it can be tilted and locked at any angle. In place of the turntable is a wooden block to which the vessel to be agitated can be fixed in various ways. The degree of agitation is controlled by varying the speed of rotation and the angle of tilt. If the latter is small the contents of a shallow dish can be kept stirred without danger of spilling. C. R. H.

Use of baking shellac varnishes for coating graphite-on-glass resistances in the laboratory. G. N. Bhattacharya (*Indian J. Physics*, 1941, 15, 59—62).—Varnishes composed of shellac and linseed oil fatty acids satisfactorily protect graphite-on-glass resistance from atm. H₂O. W. R. A.

Extraction apparatus. C. J. Pratt (*Chem. and Ind.*, 1941, 719).—A Pyrex boiling tube has four indentations, $\sim 3\frac{1}{2}$ in. front the base, on which rests a short thin-walled test-tube in the base of which is a tiny orifice. An extraction thimble is fitted into the test-tube and the boiling tube is connected to a reflux condenser. The thimble is kept immersed in the solvent by adjusting the temp. of the heating bath. Replacement of the orifice tube and thimble by a closed tube permits the solvent to be recovered and the extract to be dried off in the outer tube. J. W. S.

Cure of bumping in mercury-glass diffusion pumps. N. K. Adam and E. W. Balson (*J.C.S.*, 1941, 620).—Bumping may be prevented by allowing a few hundred c.c. of H₂S to pass through the pump at room temp. and 1 atm. O. D. S.

Vacuum lock. L. A. Delasso and E. C. Creutz (*Rev. Sci. Instr.*, 1941, 12, 450).—A simple, quick-acting vac. lock to facilitate the introduction of successive targets of short-lived radioactive substances into a β -ray spectrograph without breaking the vac. employs a sliding target well which passes through lubricated Neoprene gaskets. A. A. E.

Micro-chamber for low temperatures. Z. Harvalik (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 581—583).—A micro-chamber for observing chemical and biological processes at temp. between 80° and -180° is described. The sample can be observed through a microscope, to which the chamber can be attached. The temp. range is obtained by circulating H₂O, oil, ice-salt mixtures, solid CO₂-COMe₂ mixtures, or liquid air. L. S. T.

Laboratory fractionating column head. T. J. Suen (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 519).—A combination of two well-known types of head is described. L. S. T.

Volumetric tubes for small volumes. F. E. Holmes (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 586—587).—Long tubes constricted and calibrated near the closed end for vols. of 1—10 ml. are described. Advantages of these tubes over the conventional flasks are pointed out. L. S. T.

Determining solubility of gases and vapours in liquids.—See A., 1941, III, 946.

Magnetic stirrer for an evacuated sorption apparatus. S. A. Woodruff and A. J. Stamm (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 565).—A glass rod flattened at one end is made to oscillate in the liquid to be stirred by means of its attachment to a sealed glass tube containing an Fe nail, which is operated by an external electromagnet. L. S. T.

Improved tangentimeter. H. P. Simons (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 563—564). L. S. T.

Portable unit for determination of halogenated hydrocarbons.—See B., 1941, II, 365.

Portable [gas] sampling unit.—See A., 1941, III, 820.

[Instrument for] determination of firedamp content of mine air.—See B., 1941, I, 479.

Microanalysis of gases. Combined Toepler pump and McLeod gauge designed for micro-analysis with dry reagents. W. L. Haden, jun., and E. S. Luttrupp (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 571—572).—The all-glass apparatus described is suitable for the analysis of 5–500 cu.mm. of gas at 1 atm. Typical analyses for CO with Ag₂O as solid absorbent are recorded. L. S. T.

Nomograph for dissolved oxygen saturation in water.—See B., 1941, III, 303.

XII.—LECTURE EXPERIMENTS AND HISTORICAL.

Paracelsus (1493–1541). J. R. Partington (*Nature*, 1941, 148, 332—334). L. S. T.

XIII.—GEOCHEMISTRY.

Determination of ozone and nitrogen dioxide in the atmosphere. J. L. Edgar and F. A. Paneth (*J.C.S.*, 1941, 519—526; cf. A., 1938, I, 478).—Vals. for the O₃ content of the London and Southport atm. have been determined by the method previously described (A., 1941, I, 482); they vary between 0.4×10^{-6} and 4.5×10^{-6} vol.-% with accuracy 10%. The NO₂ content of a no. of the same air samples varied from $<0.05 \times 10^{-6}$ to 2.0×10^{-6} vol.-%, with accuracy 15%. O. D. S.

Isotopic composition of the Arctic seas and ice. A. E. Brodski and N. P. Radtschenko (*Acta Physicochim. U.R.S.S.*, 1940, 13, 145—156).—Data on the isotopic compositions of a no. of samples of H₂O of varying arctic origin are given. They fall into three groups, having respectively low D content and high ¹⁸O content; high D content and normal ¹⁸O content; and normal D and high ¹⁸O content. F. J. G.

Theory of dynamics of manganese and iron stratification in "eutropic" lakes. W. Einsle (*Naturwiss.*, 1940, 28, 257—264).—The distribution of Mn and Fe in "eutropic" lakes (i.e., waters rich in fish) has been investigated. Mn is present in greater concn. than Fe in the upper layers. This may be due to differences in the properties of Fe and Mn compounds, especially to the difference in the ease of reduction of Mn(OH)₂ and Fe(OH)₃, and the conversion of the comparatively readily sol. H carbonates of Mn⁺⁺ and Fe⁺⁺ into the insol. Mn₂O₃ and Fe₂O₃. Since H₂S will not reduce Fe(OH)₃ at $p_H > 6.7$, H₂S can be a factor in the question only in lakes of relatively low p_H . Comparatively large amounts of Mn(OH)₂ and Fe(OH)₃ can be reduced by small quantities of decaying plankton. Mn(HCO₃)₂ and Fe(HCO₃)₂ are stable only in waters poor in O₂. These considerations are applied to the problem of the varying concns. of Fe and Mn at different depths and at different times of the year. During a stagnation period there must be a gradual change in the ratio of Mn to Fe in favour of Fe. A. J. M.

Pigments from marine muds. D. L. Fox and L. J. Anderson (*Proc. Nat. Acad. Sci.*, 1941, 27, 333—337; cf. A., 1937, I, 430).—Mud samples taken at 201—1750 m. below the surface of the Gulf of California and 0.67—17.0 ft. below the surface of the bed contained H₂S or CH₄ + H₂ but no O₂. Extraction with CMe₂, dissolution in light petroleum, and chromatographic absorption on CaCO₃ and Ca(OH)₂ showed the presence of carotenoids (probably β -carotene, smaller amounts of α -carotene, and pigments similar to rhodopurpurin, torulene, fucoxanthin, lutein, zeaxanthin, and astacene) and green pigments presumably derived from chlorophyll. One green pigment had absorption max. at 507, 537, 611, and 667 m μ . in EtOH and 510, 546, 630, and 682 m μ . in CHCl₃. EtOH-KOH converted the green pigments into substances with spectra similar to but simpler than those of the parent pigments. No chlorophyll was present. One sample of mud from the bed of the open sea contained a fluorescent non-carotenoid pigment having absorption max. at 575 and 554 m μ . This pigment closely resembled one obtained from crude heavy

petroleum. The pigment content of one dried mud sample was ~6 mg.-%. W. McC.

Ionic effects on the rate of settling of fine-grained sediments. L. R. Dreveskracht and G. A. Thiel (*Amer. J. Sci.*, 1941, 239, 689—700).—The effects of 0.01—0.5M-NaCl, -KCl, and -MgCl₂ on fine-grained sediments of marl, shale, silt, kaolinite, illite clay, fireclay, glacio-lacustrine clay, volcanic ash, bentonite, and diatomaceous earth are described. Settling times are tabulated and recorded graphically. Ions in solution affect the textures of fine-grained sediments by tending to flocculate the fine particles. The aggregates encmesh larger particles and retard the sorting that would occur by normal settling; a uniform, even-textured deposit devoid of laminations is formed. The more rapid is the rate of settling of flocculated clays, the thicker is the resulting layer of sediment. Mg⁺⁺ forms a thicker layer than Na⁺. The larger aggregates formed by bivalent ions pack less closely than those formed by univalent ions. Chemical or mineralogical variations in fine sediments have little effect on the rate of sedimentation, but textural uniformity is a factor in the rate of settling and in the degree of compactness of the resulting sediment. L. S. T.

Taveyannaz sandstone in the Dents du Midi. L. W. Collet and M. Gysin (*Arch. Sci. phys. nat. Suppl.*, 1941, [v], 23, Suppl., 47—51).—The minerals and volcanic and other rocks present in the sandstone are described. J. W. S.

Discovery of celestite in the Trichy district. N. Jayaraman (*Current Sci.*, 1941, 10, 299).—Polemical. L. J. J.

Ternary system pseudowollastonite-akermanite-gehlenite. E. F. Osborn and J. F. Schairer (*Amer. J. Sci.*, 1941, 239, 715—763).—This system has been investigated experimentally by the normal quenching method of the Geophysical Laboratory, Carnegie Institution, Washington. It is a ternary system within the quaternary system CaO-MgO-Al₂O₃-SiO₂, and combines simple members of two groups of rock-forming minerals, the melilites (I) and the pyroxenoids. The max. no. of cryst. phases in equilibrium with liquid is only two, viz., an akermanite-gehlenite solid solution, (I), and α -CaSiO₃ (pyroxenoid). There is no ternary eutectic, and the lowest temp. at which liquid is present is 1302°, at the ternary min. on the boundary curve between the fields of (I) and α -CaSiO₃. The composition at this min. is CaSiO₃ 51, Ca₂MgSi₂O₇ 20, and Ca₂Al₂SiO₇ 29%. Liquidus data for the ternary system, the equilibrium diagram with isotherms, new data for the binary systems, and data that locate the three-phase boundaries and conjugation lines are given. With perfect fractionation, all ternary liquids yield a final solution that approximates to Ca₂MgSi₂O₇ 41 and Ca₂Al₂SiO₇ 59%. Zoned solid solution crystals possessing one or more reversals in the direction of zoning may be produced by normal processes of crystallisation with continuously decreasing temp. The relation of the results to the composition of (I) in igneous rocks is discussed. L. S. T.

Metamorphic origin of selenite. H. C. Cooke (*Amer. J. Sci.*, 1941, 239, 658—660).—The development of crystals of selenite (I) in gypsum (II) beds of North Shore, Cape Breton Island, is described. (I) is confined to beds that have been deformed strongly. It formed from (II) as an effect of deformation after shearing movement had ceased completely. L. S. T.

Dolomite orientation in deformed rocks. H. W. Fairburn and H. E. Hawkes, jun. (*Amer. J. Sci.*, 1941, 239, 617—632). L. S. T.

Leucite-bearing rocks from New South Wales, with special reference to an ultrabasic occurrence at Murrumburrah. M. H. Harvey and G. A. Joplin (*J. Proc. Roy. Soc. N. S. Wales*, 1940, 74, 419—442).—The petrography and petrogenesis of the Murrumburrah and other deposits are described. Comparison with limburgite deposits suggests that the Murrumburrah deposit is a leucite-monchiquite. The val. (~4.5) of the K₂O : Na₂O ratio is too high for the deposit to be regarded as a leucite-basalt. C. R. H.

Pre-Pleistocene initiation of deep solution in the lower Tennessee Valley. R. Rhoades (*Amer. J. Sci.*, 1941, 239, 764—770).—In the lower Tennessee Valley, limestone bedrock is dissolved along lines of structural control, frequently to unusual depth. One zone of solution contains sand from the upper Cretaceous Ripley formation which formerly covered the area but has been eroded subsequently by the Tennessee

River. The present solution channel, which is still undergoing solution, was in an advanced stage of development in the late Pliocene period. L. S. T.

Morphology of pyrite. V. Rosický (*Z. Krist.*, 1940, 103, 30—40).—Morphological and goniometric data showing certain new forms are recorded for large pyrite crystals from Gellivara (Sweden), Bakovića (Jugoslavia), Rio Marina (Elba), and Traversella and Brosso (Piedmont). A special goniometer for large crystals (cf. *Publ. Fac. Sci. Univ. Masaryk*, 1933, No. 179) is briefly described. A. J. E. W.

Rocks and minerals from the Lin Chia Tai [pyrite] mine, Manchuria. K. Murayama (*Mem. Ryojun Coll. Eng.*, 1941, 14, 61—66).—The district is composed of lower Proterozoic limestone, biotite-gneiss, tourmaline-granite, hornblende-gneiss, tourmaline-pegmatite, and alluvial deposits. The replacement ore deposit is embedded in the biotite-gneiss and the tourmaline-granite. Pyrite, accompanied by chalcopyrite, is the chief ore mineral. Gangue minerals are biotite, quartz, calcite, hornblende, epidote, and chlorite. The average grade of the ore is 18—20% of S. L. S. T.

Ore deposit of the Pan Ling copper mine, Manchuria. K. Murayama (*Mem. Ryojun Coll. Eng.*, 1941, 14, 53—59).—The district is composed of pre-Cambrian dolomitic limestone. The hydrothermal ore deposit fills bedding planes of the limestone. The ore mineral is chalcopyrite accompanied by small amounts of pyrite, malachite, and chalcantinite. Dolomite, with small quantities of quartz and calcite, forms the gangue mineral. The average grade of the ore is ~2% of Cu; that of the conc. ore is 5—7% of Cu. L. S. T.

Geology and ore deposit of the Ma Lu Kou mine, Manchuria. K. Murayama (*Mem. Ryojun Coll. Eng.*, 1941, 14, 41—52).—The district is composed of Ordovician limestone, granite-porphyrates, porphyrite and basalt dykes. The limestone is metamorphosed by granite-porphyry intrusions. Ore minerals are magnetite, chalcopyrite, pyrite, molybdenite, galena, limonite, azurite, malachite, chalcocite, and bismuthinite. Gangue minerals are quartz, calcite, siderite, garnet, epidote, fluorite, gehlenite, tourmaline, augite, and phlogopite. Average grade of ore is 4 g. of Au and 60 g. of Ag per ton, 5% Cu, and 1.2% Mo. L. S. T.

Geology and ore deposit of the Sha Chin Kou copper mine, Manchuria. K. Murayama (*Mem. Ryojun Coll. Eng.*, 1941, 14, 31—39).—The district is composed of pre-Cambrian quartzite, limestone, phyllitic slate, diabase, hornblende-lamprophyre, and porphyrite. The chief ore minerals are chalcopyrite, malachite, and limonite, with small amounts of pyrite, azurite, and chalcantinite. Gangue minerals are quartz, calcite, barite, siderite, chlorite, and fluorite. The average grade of ore is 5% Cu, 3.5 g. of Au and 8—20 g. of Ag per ton. L. S. T.

Cristobalite. H. Inuzuka (*J. Geological Soc. Japan*, 1940, 47, 367—375; *Rev. Phys. Chem. Japan*, 1941, 15, 57).—The formation of cristobalite from SiO_2 , agate, Si, powdered talc, and SiO has been followed by X-ray or electron diffraction methods. The lowest temp. at which it is formed is ~600°. J. W. S.

Turquoise deposits of Colorado. R. M. Pearl (*Econ. Geol.*, 1941, 36, 335—344).—Deposits at Villagrove, Manassa, Leadville, and Creede are described. They occur in weathered acid igneous rocks rich in alkali feldspar, and the turquoise (I) is found as veins and nodules in faults, fissures, and cavities. The lode deposits were formed by circulating meteoric waters that leached and conc. the constituents of (I) from the surficial rocks, and pptd. them from cold solution in fracture and shear zones. P was derived probably from apatite, Cu from Cu ores, and Al from the alteration of feldspar. Fe and SiO_2 are impurities. L. S. T.

Dravite-bearing rocks from Dinas Head, Cornwall. S. O. Agrell (*Min. Mag.*, 1941, 26, 81—93).—The tourmaline present in the adinoles (A., 1939, I, 392) is a magnesia-tourmaline (dravite). It forms minute needles and its presence can sometimes be detected only by testing the rock for B and by X-ray examination. Analysis of a rich dravite-rock gave B_2O_3 8.64, MgO 6.96%, etc. and approximates to the composition of tourmaline. The B has probably been derived from an underlying granite mass. L. J. S.

Mineral localities on the Mendip Hills, Somerset. A. W. G. Kingsbury (*Min. Mag.*, 1941, 26, 67—80; cf. Spencer, A., 1923, ii, 774).—Specimens recently collected in small amounts

are described. X-Ray examination (by F. A. Bannister) of the "greenockite" previously reported (A., 1940, I, 136) shows only the lines of smithsonite. A list is appended of 47 mineral species recorded from the district. L. J. S.

Alteration products of stibnite. W. R. Schoeller (*Min. Mag.*, 1941, 26, 94—96).—Pseudomorphs of Sb-ochre after prismatic crystals of stibnite from Sinhoa, Hunan, China, are buff-coloured with d 4-16. The powder is insol. in hot HCl but sol. on addition of SnCl_2 ; heating with HCl and KI liberates I. Analysis gave Sb 70.54, SiO_2 1.94, Fe_2O_3 0.16, S 0.16, H_2O 4.50, which is interpreted as $\text{Sb}_2\text{O}_3 \cdot 93.17$, $\text{Sb}_2\text{S}_3 \cdot 0.57$, giving a total of 100.34. This gives a formula $\text{Sb}_2\text{O}_3 \cdot \text{H}_2\text{O}$, different from those of other ill-defined Sb-ochres. L. J. S.

Flotation of sand in nature. V. E. McKelvey (*Amer. J. Sci.*, 1941, 239, 594—607).—The floating of sand on H_2O is a surface tension effect. The surfaces of the grains are protected from wetting by a film of adsorbed air. If the adsorbed film is displaced by H_2O or if the surface film is broken, the grains sink. Floating sand is more common than is realised, and has geological importance. L. S. T.

Origin of the tungsten ores of Boulder Co., Colorado. T. S. Lovering (*Econ. Geol.*, 1941, 36, 229—279).—The general geology, and the wall rock alteration, including mineralogy, chemical changes, and the character of solutions causing alteration, are described. Chemical analyses [J. G. Fairchild] of altered wall rocks are recorded. The mineralogy indicates sustained attack by early acid solutions that changed finally to neutral and alkaline solutions. Sericitic alteration is conspicuous next to the Au telluride veins. The mineralogy of the W and telluride vein filling indicates a progressive change from acid to alkaline solutions. Ferberite was pptd. in slightly acid solutions, and galena, tetrahedrite, and the Au tellurides are later and were pptd. probably in alkaline solutions. The magmatic origin of the ores is discussed. L. S. T.

Heat energy from radioactive sources in the earth. W. D. Urry (*J. Washington Acad. Sci.*, 1941, 31, 273—284).—The heat production in a rock sample can be determined with sufficient accuracy for geochemical purposes by measurement of the rate of α -particle emission, provided that the K_2O content of the sample is known. The method of calculation is illustrated. An uncertainty of <5% in this calculation is introduced by a lack of knowledge of the exact val. of the Th : U ratio of the rock. When the K_2O content is unknown the probable error increases to 15—25%. The importance of the ratio of the rate of production of radioactive heat in the past to that at present is discussed. No significant increase in heat production within the structure of the earth during the accepted age of the earth (2×10^9 years) appears probable. The possibility of the existence of radio-elements hitherto undetected is explored from the point of view of their influence on the ratio of heat production in the past to that at present. L. S. T.

X-Ray analysis of a wolframite crystal. S. M. Bunin, A. I. Klimov, and M. M. Umanski (*J. Phys. Chem. Russ.*, 1940, 14, 844—845).—A monocrystal of wolframite had a rhombic lattice with $a : b : c = 0.835 : 1 : 0.870$, spacings in the [100], [010], and [001] directions being 4.78, 5.73, and 4.98 Å. It belongs to the space-group C_{2h} . J. J.

Optical properties and crystallography of zoned pumpellyite from the Witwatersrand. J. E. de Villiers (*Amer. Min.*, 1941, 26, 237—246).—Pumpellyite from the Witwatersrand is intensely zoned, and shows unusually wide variations in optical properties. L. S. T.

Whitlockite: a new calcium phosphate, $\text{Ca}_3(\text{PO}_4)_2$. C. Frondel (*Amer. Min.*, 1941, 26, 145—152).—Whitlockite (I), rhombohedral, a_0 10.32, c_0 36.9 ± 0.1 Å, a $44^\circ 6\frac{1}{2}'$, space-group probably $R\bar{3}c$, hardness 5, $\rho_{\text{calc.}}$ 3.12, $\rho_{\text{meas.}}$ 3.19, unit cell $\text{Ca}_{21}\text{P}_{11}\text{O}_{50}$, occurs as a late hydrothermal mineral in granite pegmatite at the Palermo quarry, near North Groton, New Hampshire, in the sequence (I) and quartz, rhodochrosite, apatite (II), zeolite. (I) is distinct structurally from graptolite, caryinite, fillowite, and (II). X-Ray powder diagrams, and a chemical analysis [F. A. Gonyer] are reproduced. Small amounts of Mg and Fe^{III} replace Ca. L. S. T.

X-Ray crystallography of shortite. W. E. Richmond (*Amer. Min.*, 1941, 26, 288—289).—Shortite (A., 1939, I,

586) has a_0 4.98, b_0 10.97, c_0 7.10 Å., $\rho_{\text{obs.}}$ 2.60, $\rho_{\text{calc.}}$ 2.59; space-group D_{2h}^{22} . The unit cell contains $2[\text{Na}_2\text{CO}_3, 2\text{CaCO}_3]$. L. S. T.

Progressive metasomatism of serpentinite in the Sierra Nevada of California. G. A. Macdonald (*Amer. Min.*, 1941, 26, 276—287).—Serpentine (I) nodules enclosed in mica schist close to a body of intrusive quartz diorite have been altered by igneous emanations. Cores of residual (I) are surrounded by successive envelopes of talc (II), (II) and actinolite (III), (III), chlorite, and biotite. Chemical and micrographic analyses indicate that the changes involved loss of MgO from the nodules, and addition of SiO_2 in the inner zones and of small amounts of other oxides in the outer zones. L. S. T.

Paragenesis of the pegmatite minerals of Striegau, Silesia. W. D. Michell (*Amer. Min.*, 1941, 26, 262—275).—Pegmatites in a granite mass at Striegau contain many open druses, in which the minerals described were deposited. The first, or magmatic, stage of mineralisation included the formation of the main quartz-felspar pegmatite bodies. The cavities were formed probably during the second or albitisation stage, during which albite and cleavelandite were deposited in the druses, and replaced some of the orthoclase. Chlorite (strigovite, prochlorite, and penninite), tourmaline, fluorite, epidote, clinozoisite, and axinite belong to the next period of druse filling. Zeolites, chiefly stilbite, characterise the fourth stage of mineralisation, and calcite the final stage. L. S. T.

Djalmaite, a new radioactive mineral. C. P. Guimarães (*Amer. Min.*, 1941, 26, 343—346).—*Djalmaite*, octahedral, ρ 5.75—5.88, hardness 5.5, n 1.97, has Ta_2O_5 72.27, Nb_2O_5 1.41, TiO_2 2.54, SnO_2 trace, ZrO_2 0.80, UO_2 2.17, UO_3 9.38, WO_3 0.18, Bi_2O_3 0.98, PbO 1.10, FeO 0.56, CaO 3.40, MgO 0.24, H_2O 4.62, total 99.65%. It is related closely to betafite and samirésite, and resembles eschwegeite. It occurs as yellowish- or greenish-brown or brownish-black crystals in the alluvium of Posse Creek, Brejaúba district, Minas Geraes, Brazil. L. S. T.

Unit cell of dickinsonite. C. W. Wolfe (*Amer. Min.*, 1941, 26, 338—342).—Dickinsonite (I) from Poland, Maine, has a_0 16.70, b_0 9.95, c_0 24.69 Å., β $104^\circ 41'$; space-group C_{2h}^{22} . C_2/c ; $\rho_{\text{obs.}}$ 3.38 and 3.41, $\rho_{\text{calc.}}$ 3.42; the unit cell contains $4[\text{H}_2\text{NaMn}_{12}(\text{PO}_4)_{12}\cdot\text{H}_2\text{O}]$. (I) does not belong to the chemical type $\text{A}_3(\text{XO}_4)_2\cdot n\text{H}_2\text{O}$. Chemical analyses are given. L. S. T.

Constitution and polymorphism of the pyroaurite and sjögrenite groups. C. Frondel (*Amer. Min.*, 1941, 26, 295—315).—X-Ray and optical methods show that almost all specimens of hydrotalcite (I), stichtite (II), and pyroaurite (III), regardless of locality, are not homogeneous, but are intimate mixtures of hexagonal and rhombohedral substances of similar physical and identical chemical properties. X-Ray investigation shows that (I), (II), and (III) are isostructural. The dimorphism suggested by Aminoff and Broomé for (III) has been confirmed, and is shown to extend to (I) and (II). Data for cell contents, a_0 , c_0 , ω , and ϵ are as follows: rhombohedral or (III) group: (II), $3[\text{Mg}_6\text{Fe}_2(\text{OH})_{12}\text{CO}_3]\cdot 4\text{H}_2\text{O}$, 6.19, 46.54 Å., 1.564, 1.542; (II), $3[\text{Mg}_6\text{Cr}_2(\text{OH})_{12}\text{CO}_3]\cdot 4\text{H}_2\text{O}$, 6.18, 46.38 Å., 1.545, 1.518; and (I), $3[\text{Mg}_6\text{Al}_2(\text{OH})_{12}\text{CO}_3]\cdot 4\text{H}_2\text{O}$, 6.13, 46.15 Å., 1.511, 1.495; hexagonal or sjögrenite group: sjögrenite, $\text{Mg}_6\text{Fe}_2(\text{OH})_{12}\text{CO}_3\cdot 4\text{H}_2\text{O}$, 6.20, 15.57 Å., 1.573, 1.550; barbertonite, $\text{Mg}_6\text{Cr}_2(\text{OH})_{12}\text{CO}_3\cdot 4\text{H}_2\text{O}$, 6.17, 15.52 Å., 1.557, 1.529; manasseite, $\text{Mg}_6\text{Al}_2(\text{OH})_{12}\text{CO}_3\cdot 4\text{H}_2\text{O}$, 6.12, 15.34 Å., 1.524, 1.510. The observed structural cells derived from single crystal and X-ray powder diagrams have one half a_0 and c_0 for the rhombohedral series and one half a_0 for the hexagonal as compared with the above vals. The dimensions given above are required for rational cell contents. Brugnatellite, $\text{Mg}_6\text{Fe}(\text{OH})_{12}\text{CO}_3\cdot 4\text{H}_2\text{O}$, is distinct from the above minerals, whilst boughite and (I) are identical. New localities for (III) include Val Malenco and Val Ramazzo, Italy, and for the first occurrence in the United States, Blue Mont, Maryland. Chemical analyses and X-ray photographs are reproduced. L. S. T.

Manganese deposits in Manukau and Franklyn Counties [New Zealand]. E. O. Macpherson (*New Zealand J. Sci. Tech.*, 1941, 22, 185—192n).—Three Mn deposits (40—58% Mn) have been surveyed in order to determine the commercial possibilities of development. The geology of each region and the present working of the deposits are described. Two hypotheses to explain the origins of the deposits are offered. C. R. H.

Crystallised gold from Southern Rhodesia. A. M. Macgregor (*Min. Mag.*, 1941, 26, 97—104).—Plates of native Au >10 cm. across and 0.5 mm. thick were found in vugs along a fault plane in the Old West mine, Penhalonga. The surface (111) of the plates shows stepped triangular elevations (311), which are sometimes surmounted by small symmetrically developed crystals of Au or by tiny knobs of native Ag. The plates, freed from knobs of Ag, contain Au 81.093, Ag 18.193%. The plates are grown on clear crystals of calcite. Other associated minerals in the vugs are galena, pyrite, quartz, chlorite (analysis given), and laumontite. The Au was evidently deposited by a secondary process at a low temp., and this allowed the Ag to crystallise separately. L. J. S.

Ores of the Lupa Goldfield, Tanganyika Territory, East Africa. D. Gallagher (*Econ. Geol.*, 1941, 36, 306—323).—The veins of the Lupa Goldfield are hypothermal Au-quartz veins of simple mineralogy. The ore of the Saza mine consists of quartz (I) with carbonate-filled fractures, and contains ~1% of metallic minerals. These are (decreasing order of abundance) pyrite (II), chalcopyrite (III), galena, sphalerite, altaite, and Au. Fracturing of the (I) controlled the entrance of the metallic minerals. Danny Maher's mine contains (II), (III) with intergrowths of cubanite, indicating high temp., and abundant magnetite later than the sulphides. A relationship between the low end-temp. mineralogy of the Saza mine and its economically successful Au content, and the high-end temp. mineralogy and its unpayable Au content, is probable. L. S. T.

Albite and gold. J. A. Reid (*Econ. Geol.*, 1941, 36, 217—219).—Two instances in which albite is the dominant gangue mineral in a Au vein are reported (cf. A., 1941, I, 61). L. S. T.

Auriferous ores from Salsigne (Aude, France). M. Legraye (*Congr. int. Mines Mét. Géol. appl., Sect. Géol. appl.*, 1935, 7, 11—13; *Chem. Zentr.*, 1938, 1, 1097).—The deposits are of hypothermal origin and contain Au associated with arsenopyrite, pyrite, pyrrhotine, and chalcopyrite. A. J. E. W.

Auriferous veins of Salsigne. M. Legraye (*Ann. Soc. géol. Belg. [Bull.]*, 1938, 61, 222—224; *Chem. Zentr.*, 1938, ii, 3793; cf. preceding abstract).—The auriferous quartz has probably been deposited much farther from the original magma than the quartz-tourmaline deposits which presumably occur at greater depth. A. J. E. W.

Occurrence of a coarsely-crystalline kaolin mineral in some South African fireclays. V. L. Bosazza (*Amer. Min.*, 1941, 26, 290—292).—Fireclay from Boksburg contains opaline-looking nodules (chemical analysis given), which consist of colourless plates. The analysis and optical properties indicate that it is kaolinite. Malachite-green is adsorbed from aq. solution. L. S. T.

Rarer constituents of South African fireclays. V. L. Bosazza (*Nature*, 1941, 147, 747).—Spectrographic examination of fireclay from Middelburg, Transvaal, and from Boksburg showed the presence of V and of traces of Be; traces of Cu were found in the first clay. Ba and Sn were not found in either. Mn and Cr appear to be absent from S. African fireclays; S and P are always present. L. S. T.

Textures of clays. V. L. Bosazza (*Nature*, 1941, 147, 779).—A discussion of methods of evaluating the texture of a clay. L. S. T.

Phosphate method of determining sites and conditions of colonisation. W. Lorch (*Naturwiss.*, 1940, 28, 633—640).—Determination of the P_2O_5 in samples of soil enables conclusions to be reached concerning the presence and nature of early colonisation. Curves of P_2O_5 distribution are given for the different types of colonisation, e.g., nomadic, semi-nomadic, hunting and fishing, agricultural, etc. A. J. M.